THE tool AND manufacturing engineer

OCTOBER 1961

grinding dynamometer

AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS

A NEW TOOL-SETTING METHOD

Tool-Tronic Gage locates tool tip within .000025 by fast, simple electronic-optical method

by Alden H. Jacobson, Chief Engineer
Bore-Matic Division
The Heald Machine Company

With today's trend to greater accuracy and precision in single-point Borizing, the problem of precise tool-tip location becomes increasingly important.

Previous methods, while of high accuracy, are relatively slow and require considerable skill on the part of the operator. The optical method, using a precision-calibrated microscope, is dependent on the relative degree of operator eye fatigue. If eyestrain is a result, such an undesirable condition is known as "eyeballing." And the touch method, using dial indicators, often causes microscopic damage to the cutting edge with resulting impairment of the finished surface.

Here at Heald we have devoted a great deal of research to devise a method of tool-setting which would maintain the highest accuracy, prevent tool tip damage, and require no special operator skill.

The result is the new Tool-Tronic Gage illustrated here. Tool tip location is precisely determined by optical means, with electronic amplification giving highly accurate readings on two large meter scales.

The unit consists essentially of a sensing head which contains the light source, optics and photo cells, and a separately mounted amplifier and meter case. The sensing head is mounted vertically on the machine near the workhead, where the tool can be positioned into gage opening. As the tool is moved into place by operation of the table and cross slide, it interrupts the light rays and the amount of light passing on each side of the tool is compared to reference photocells and read out on two large horizontal-scale meters. To locate the tool with an accuracy of 25 millionths, it is only necessary to move tool in X and Y directions until the pointers on both meters are centered on the "zero" mark. For the operator to determine this precise position and return to it whenever desired requires no more skill or experience than that needed to operate the machine.

The Tool-Tronic Gage can be used with most types of single-point boring and turning machines. It should prove especially valuable on numerically-controlled contour Borizing equipment where extreme precision is required.

Tool-Tronic Gage, showing meter case, sensing head and cable.

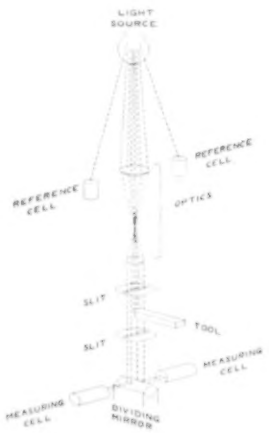

Diagram showing principle of operation of Tool-Tronic sensing head.

Tool-Tronic gage in use on a numerically-controlled Heald Model "S" Bore-Matic. Sensing head (arrow) receives tool and centering indication is read on meters at right.

Your Heald engineer will be glad to arrange a demonstration of this new tool setting gage for you, in your plant or ours.

It Pays to come to Heald

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THE tool AND manufacturing engineer

October 1961 Vol. 47, No. 4

Getting Results from Company Research Programs ..... *By Maurice Nelles* 75
When research departments are given well-defined goals and positive leadership, the payoff in results is tremendous.

Gadgets 79
Forming die mandrels strip workpiece . . . "rocking chair" edge finder for drilling . . . chuck modified for high repetitive accuracy.

Dynamic Wheel Hardness Testing ..... *By T. W. Black* 83
Performance of a grinding wheel in service can be reliably predicted from the results of a 45-second dynamic hardness test.

Tooling With Granite ..... *By V. E. Diehl* 87
Black granites, stiffer and denser than ordinary granites, are replacing metal in some precision tooling.

Designed for Production 90
Building-block drilling machine has high versatility . . . Rotary index machine does over-under drilling . . . pipe welder ups production.

Chemical Milling Today ..... *By C. H. Rose* 93
With the advent of new techniques, chemical milling capabilities have been broadened. The process has great cost-cutting potential.

Semiautomatic Welding Simplifies Fixturing ..... *By H. F. Kocher* 97
When semiautomatic welding replaced manual welding at one plant, welding output was upped 30 percent and fixturing reduced.

Numerical Control in Japan 99
Japanese numerical control systems are highly sophisticated and they are being successfuly applied to a wide range of applications.

Tools at Work 102
High-energy-rate forming of piston caps . . . carbide reamer simplifies finishing . . . big press molds heated plastics.

Precision Hole Boring with Portable Tools ..... *By Richard Mase* 105
An aircraft manufacturer is drilling large-diameter holes in wings without heavy equipment or elaborate fixturing.

Engineered Production of Carbide Dies ..... *By Daniel B. Dallas* 107
Research, employee training and advanced engineering are some of the factors needed for low-cost production of complex dies.

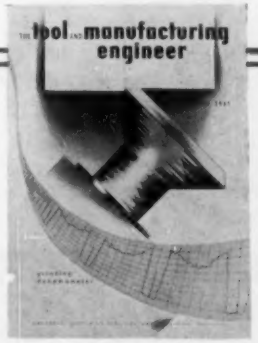
Machining Cobalt Superalloys (Reference Sheet) ..... *By C. T. Olofson and F. R. Morral* 111
Despite their hardness, cobalt superalloys can be drilled, turned and faced without undue difficulty when appropriate techniques are used.

ASTME IN ACTION—Economy in Manufacturing 113

Preview of this issue 5
President's Message 73
Engineering Bookshelf 174
Field Notes 155
Letter from the Editor 3
Looking Ahead (Newsletter) 7
Men at Work 161
Progress in Production 125
Readers' Viewpoints 164
Tech Digests 183
Technical Shorts 167
Tool Engineering in Europe 171
Tools of Today (New Products) 127
Trade Literature 177
Who's Meeting and Where 158

THIS MONTH'S COVER

Traditionally, grinding wheel hardness has been tested statically. Static tests do not always reveal whether or not a wheel will perform satisfactorily in service. A new dynamic test method is symbolized on this cover. A conical cutter makes a pass across a grinding wheel. Crushing forces are recorded on a strip chart. As explained in the article starting on page 83, these forces indicate wheel hardness.



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Build Better Products

The answer to our economic problems will always be the same. It is simply: Do a better job. Build a better machine. Develop a better process. Install a better method. By better is meant better than that of competition. Those who are not content to be second best have what it takes to succeed. The old saying, "Where there is a will there is a way" is as true today as when it was first said. Our greatness has developed from our wealth—wealth in both natural resources, in creative ability and in managerial acumen.

The manufacturing engineer gives shape and use to our materials. He gives utility to them. It is he who materializes managerial ideas and aspirations. No matter how good an idea, it remains for the engineer to construct the product involved in the quantities desired and in a manner that it may be sold at a profit in a competitive market.

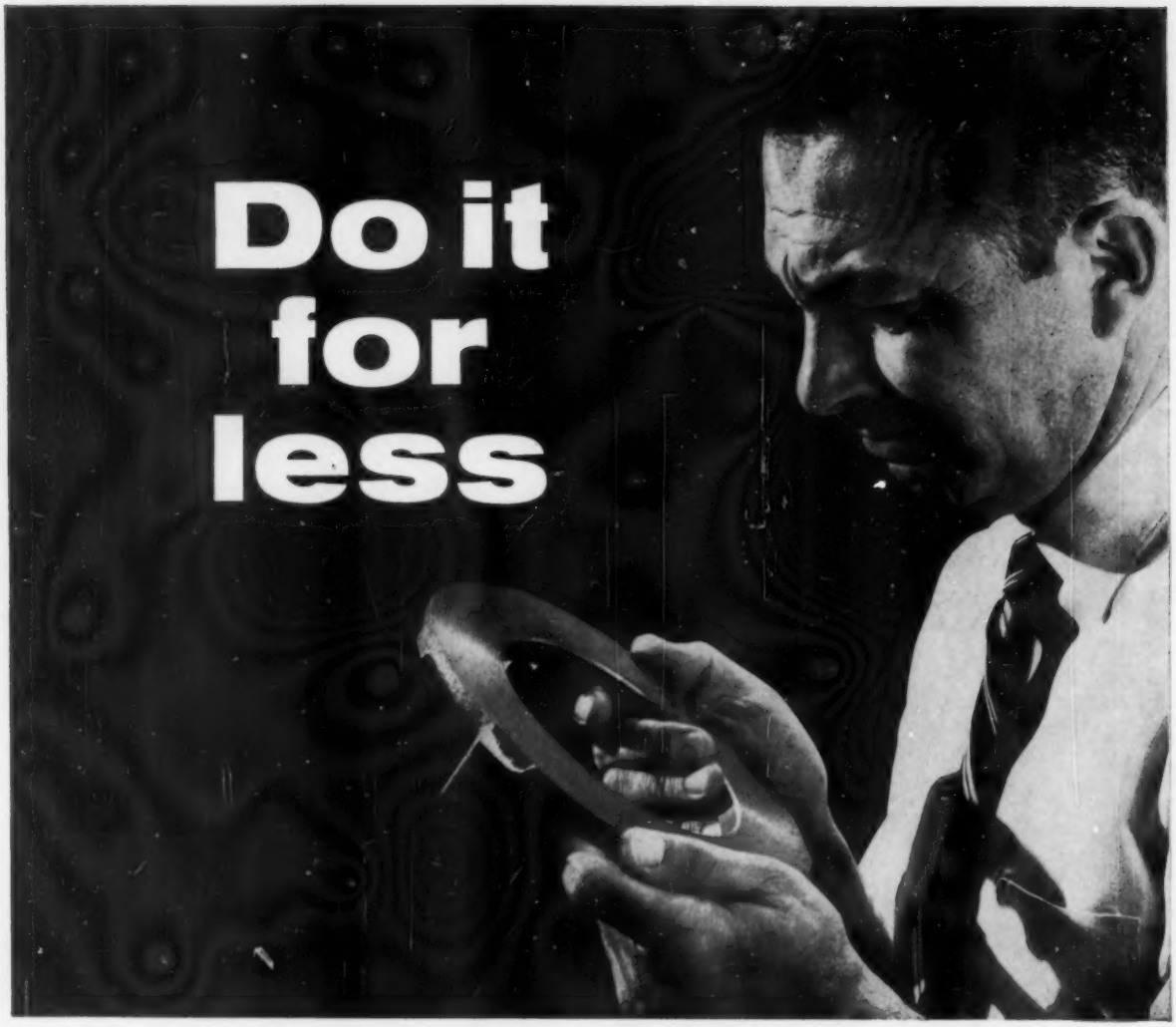
In times of reduced production schedules, like those we have been experiencing recently, it takes courage and confidence to plan boldly for the future. This is where management has a vital role and can serve effectively by providing leadership, inspiring confidence in the future.

When schedules have been curtailed because demand has been reduced, the time for marketing the creations of the research and development laboratories is at hand, if not past due. It is the time to build and announce new and more versatile products. This is the spirit that has always prevailed and always will.

This spirit is more frequently found in small companies than in extremely large organizations. The small company is down to earth, sensitive to the needs of the times and highly adaptable to changing conditions. It is not operating on a percentage like a baseball team but is willing to apply common sense to its immediate problems. We need products of all kinds. We also need companies of all sizes. These insure our future to serve customers of all kinds.

John W Greve

EDITOR



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preview

. . a fast look at this issue

Cutting Down the Ivory Tower

There's a widely held opinion that research is an activity that's best conducted in an ivory tower—an activity that should be divorced from the usual management controls and the profit motive. Not so, says Dr. Maurice Nelles, who has been practicing what he preaches for many years as a top research and company executive. Research, in manufacturing companies at least, should be directed toward the ultimate development of new products and processes. To get results, company management must give the research department well-defined goals—and the personnel and facilities necessary to attain those goals by a certain time. Dr. Nelles' comments are not applicable, perhaps, to basic scientific research, but they will be of real interest to the management of any company that is interested in improving its competitive position. See Page 75.

Cutting Grinding Wheel Breakdowns

One company that is getting results from research is Macklin Co., Michigan-based manufacturer of grinding wheels. Feeling that all present methods of testing grinding wheel hardness were inadequate, Macklin sponsored research that led to the development of a new test method that enables wheel hardness to be evaluated after a 45-second check. In the new method, wheels are tested dynamically, rather than statistically and the results are permanently recorded on a chart. So reliable is the dynamic method that it is being considered for industry-wide standardization. Details are given in an artcle by TME staffer T. W. Black, Page 83.

Cutting—and Applying—Granite

V. E. Diehl, manager of physical standards of Ampex Corp. is an expert on new applications of granite in industry. As he points out in his article, Page 87, just about everybody is familiar with the use of granite for surface plates. Now people are starting to use black granite—which is stiffer and less porous than ordinary granite—for precision instrument and tool applications. Plenty of examples are given in the article, which also discusses the machining of granite in some detail.

Cutting With Chemicals

Watervliet Arsenal engineer C. H. Rose recently made an extensive study of chemical milling operations to see if this relatively new process was suitable for metal-removal on complex workpieces of hard materials. His finding: chemical milling, once restricted to a few operations on special materials in the aircraft industry, is now being widely applied to a multitude of metal-removal tasks. Usually, cost savings have resulted and in some cases chemical milling has proved to be the only satisfactory method for machining problem workpieces. Examples are given in Mr. Rose's article, Page 93.

Cutting Welding Costs

Weldments that were formerly produced by manual methods are now being fabricated with semiautomatic equipment at Gehl Brothers Manufacturing Co. One of the men responsible for the change is assistant plant manager H. F. Kocher, who tells about the equipment and the results in an article starting on Page 97. Inner shield squirt welding—a new technique—is employed. The process doubles and sometimes triples welding speed and has resulted in a 28 percent reduction in welding costs.

Cutting With Tape

Two professors at Kyoto University, Keiji Okushima and Katsundo Hitomi, recently surveyed the status of numerical control in Japan. Their findings, summarized in the article starting on Page 99, show that Japanese manufacturing engineers and the Japanese control industry have been working with numerical control for nearly as long as American engineers and that applications are following the trends seen in America. Conclusion: American industry has no monopoly where sophisticated automation is concerned.

Cutting Cobalt Superalloys

Battelle Memorial Institute researchers C. T. Olofson and F. R. Morral have studied the machining of superalloys containing cobalt. Specific feed, speed and tool recommendations appear in a Reference Sheet based on the Battelle findings, Page 111.

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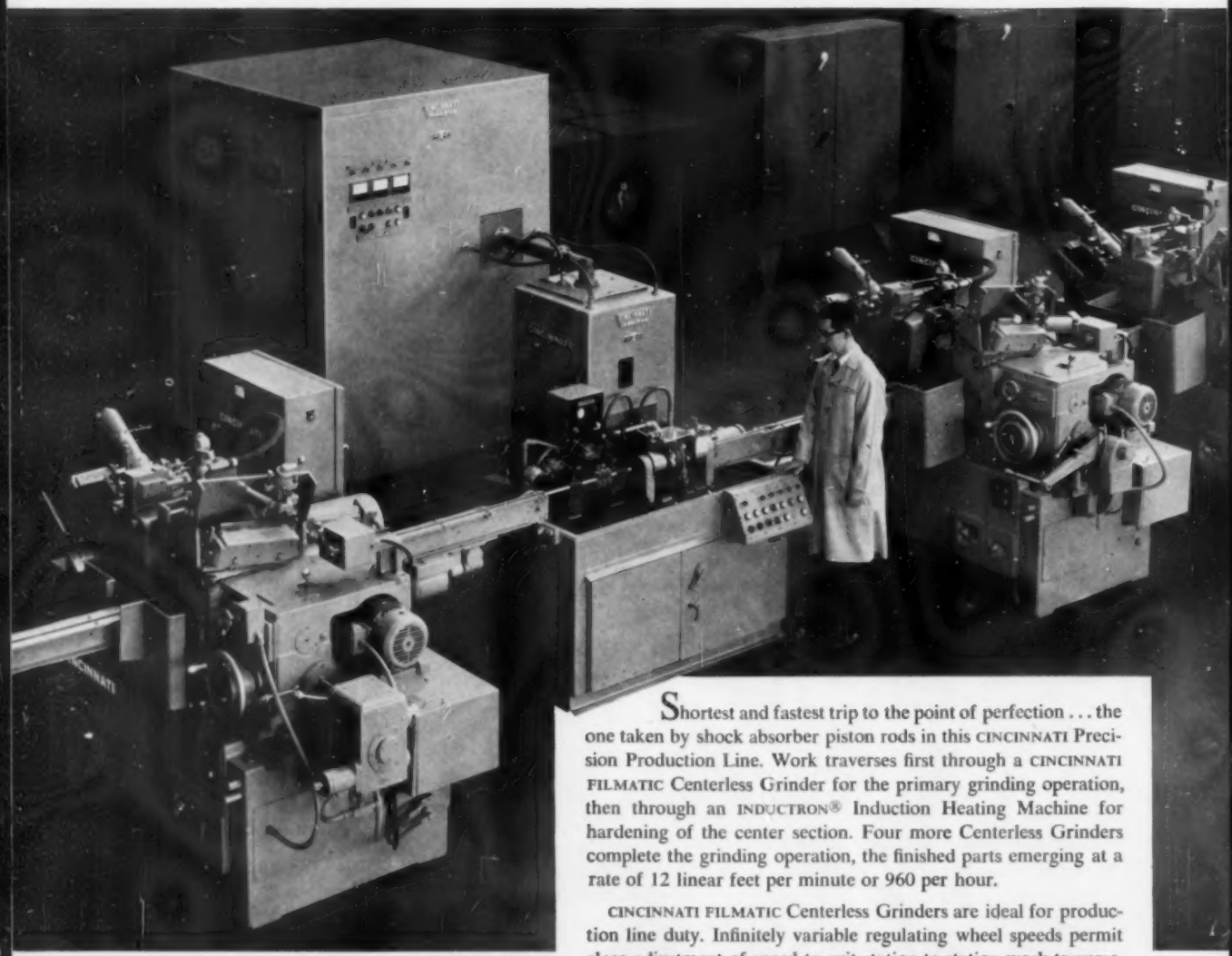
Twelve linear feet of parts every minute

hardened and ground on . . .

CINCINNATI Precision Production Line



Perfection, 960 times every hour. Continuous flow of shock absorber piston rods, selectively hardened and centerless ground on this CINCINNATI Precision Production Line, eliminates unnecessary work handling. Line consists of five CINCINNATI FILMATIC Centerless Grinders and one INDUCTRON Induction Heating Machine.

Shortest and fastest trip to the point of perfection . . . the one taken by shock absorber piston rods in this CINCINNATI Precision Production Line. Work traverses first through a CINCINNATI FILMATIC Centerless Grinder for the primary grinding operation, then through an INDUCTRON® Induction Heating Machine for hardening of the center section. Four more Centerless Grinders complete the grinding operation, the finished parts emerging at a rate of 12 linear feet per minute or 960 per hour.

CINCINNATI FILMATIC Centerless Grinders are ideal for production line duty. Infinitely variable regulating wheel speeds permit close adjustment of speed to suit station-to-station work traverse. Simple swivel plate adjustment aligns work rest and regulating wheel unit with conveyor. FILMATIC grinding wheel spindle bearings will never stop production. Many other feature-advantages are outlined in Catalog G-727-1D, covering the Centuramic line of centerless grinders. May we send you a copy? **Grinding Machine Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.**

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LOOKING AHEAD

By T. W. Black
Senior Associate Editor

Starting salaries for graduates of engineering schools continue to rise. Cornell University reports that this year's graduating seniors started at salaries ranging from $444 to $833 a month, with a median of $566 a month for all graduates. Generally, salaries have gone up three to five percent yearly for the past several years.

Cornell reports another trend taking place in the 60's. Previously, engineers were hired at good salaries but reached a plateau midway in their careers, after which it was difficult to rise without entering some phase of administration. Increasingly, and especially in large corporations, exceptional professional engineers are being paid better than formerly without the need to resort to administrative work.

Electrolytic cavity sinking continues to set new metal-removal records -records that are made possible by larger power supply units. One company, Anocut Engineering, reports that it is using a 10,000-amp power supply to dissolve 60 cubic inches of metal per hour-three times more metal than possible with previous power supplies. The electrolytic machining process is used on extremely hard materials.

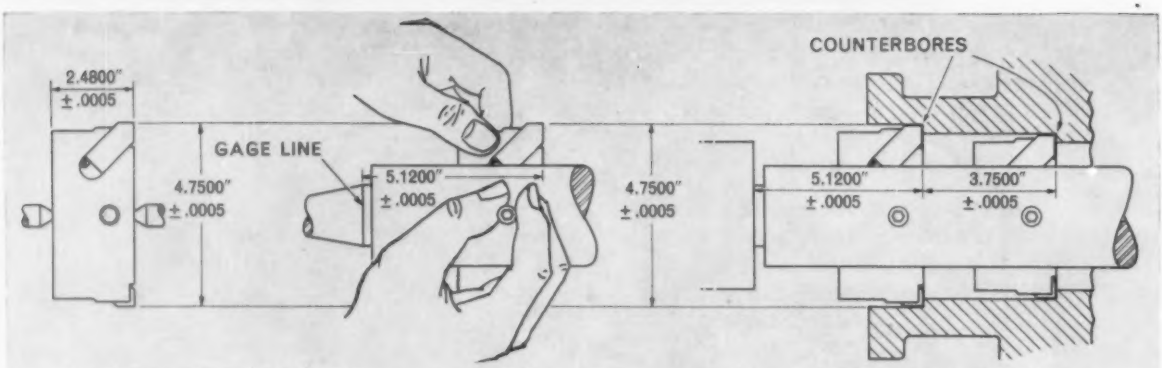
Lockheed's California Div. is now flash welding aluminum, magnesium and magnesium-thorium alloys on a production-run basis. Flash welding, long-used with steel, is accomplished by heating metal electrically to forging temperatures, then bringing the ends together mechanically--"upsetting" the metal--to make the junction.

First production use of the technique, which results in 40 percent stronger welds at 75 percent lower processing costs, is in the manufacture of aluminum alloy structural rings for missiles. With the new method, lightweight aluminum and other alloys that do not respond to ordinary fusion welding can be joined. A 400 kva flash welder performs the work.

Researchers in Stanford Research Institute's Poulter Laboratories have been studying a new process that can make diamonds from graphite, the material in a lead pencil. In this process, a quantity of graphite is placed over a container of water and exposed to an explosive charge from above. The graphite is compressed for a microsecond by a shock pressure of about 300,000 atmospheres. About five to ten percent of the graphite is converted to diamond.

The diamonds are polycrystalline--the most desirable type for industrial cutting and grinding operations--but are too small for any practical use as yet. The chief advantage of the explosive method of making diamonds is that capital investment requirements are small. Ultimately, lower diamond prices may result.

HOW TO CONTROL MACHINING ACCURACY FROM THE TOOLROOM

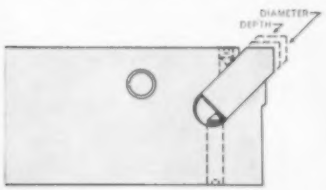


1. Assembled Davis block and cutters are ground for diameter and face-to-back-of-tool dimensions *in the toolroom*. Accurately located grinding centers make the block its own arbor, assuring precision tolerances.

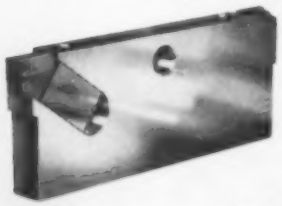
2. Toolroom accuracy is retained when block is mounted in Davis precision machined bar. A single taper locating screw accurately centers the block and locks it securely against the back of the slot, providing rigid precision alignment for depth as well as diameter.

3. Original preset depth and bore accuracy are translated to precision boring by block and bar. Accurate location of bar slots provides precise spacing between blocks for boring, facing, and other combined or successive operations.

CUTTER EXTENDS AT AN ANGLE FOR REGRINDING



Both bore *and* depth dimensions can be maintained when cutter is reground — an *exclusive* Davis feature *available at no extra cost.*



Expandable two-cutter and multicutter blocks can be toolroom ground to desired tolerances. Adjustable for regrinds.

Two-cutter blocks with throwaway tips. Accuracy of precision carbide inserts permits rough boring to .004" tolerances.

Solid block cutters also are available.

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A major feature of Davis expandable cutter design — not available in cartridge or other block-type tooling — is the angular cutter adjustment which permits grinding both the OD and the face of the cutter *without* sacrificing accurate depth dimensions. (See illustration at left.)

You are further assured that bore depth and diameter will be accurate when using tape-controlled or other automatic machines which bore according to programmed depth. By holding the face-to-back-of-block dimensions and accurately locating the block slots in the boring bar, Davis is able to furnish a boring tool package that maintains exact relationships between tools for boring, backfacing, counterboring, etc.

Standard Davis bars and block-type tooling are available for boring, backfacing, counterboring, chamfering, facing, form-cutting, or combinations of these operations within a ¾" through 17" diameter range. *For more information,* call your Davis distributor or send for literature.

Two new catalogs — Complete specifications, pricing, and ordering instructions for the Davis block tooling system are given in Block Catalog D-510-A and Bar Catalog D-520-A. Ask for your copies today.

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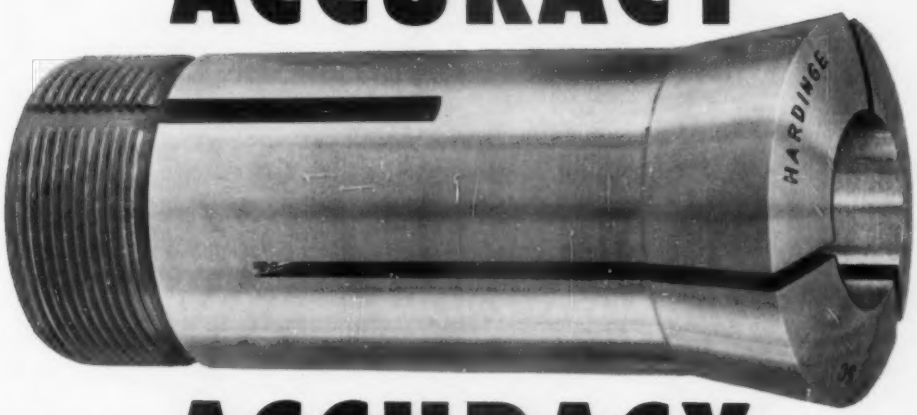

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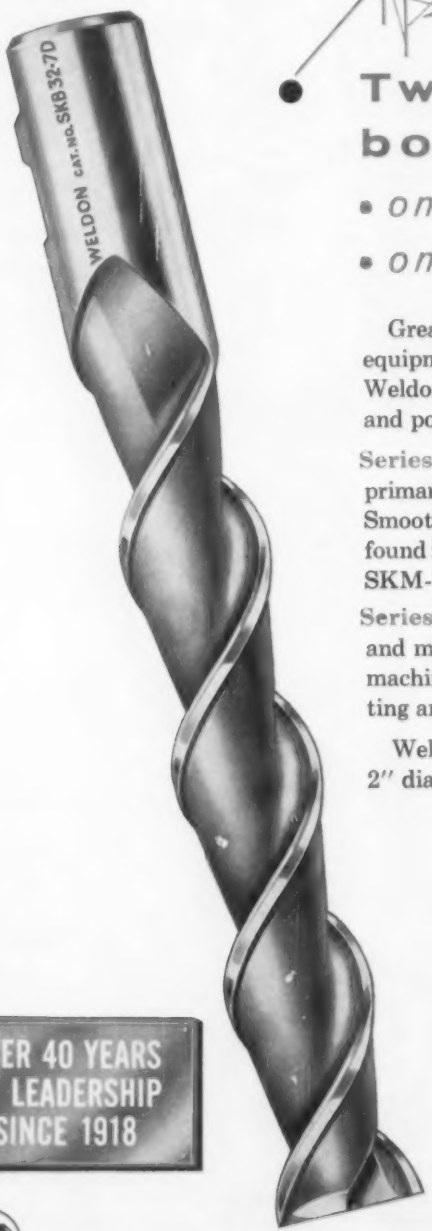

Two *Ski-Kut* styles both for ALUMINUM

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- *one for profile finishing*

Greater feeds, longer tool life, better finish, easier operation of equipment are some of the cost-cutting benefits you get when you use Weldon's patented SKI-KUT End Mills featuring a 45° helix angle and polished chip take-off land for smoother, faster shearing action.

Series SKB — Designed for heavier stock removal, the polished primary flute face and polished relief minimize adherence of chips. Smoother shearing action minimizes the hammering effect often found in 2-flute mills with slower helix angles. Write for BULLETIN SKM-1.

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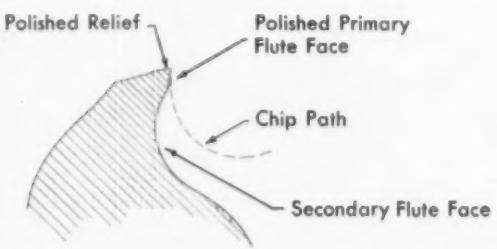
Weldon SKI-KUT End Mills are available from stock in ¼" to 2" diameters and various flute lengths.



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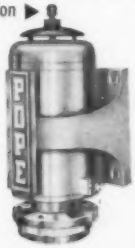

Pope P-2500, P-2700 Series heavy duty motorized spindles, 1 HP to 20 HP — 900 to 3600 RPM, for surface grinding, boring and milling.

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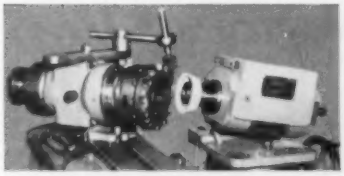
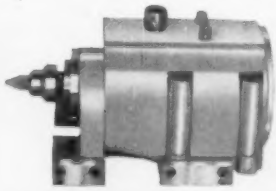
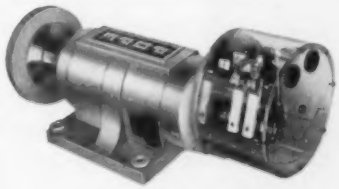


Pope P-6651-B Precision 1 to 3 HP motorized angularly adjustable head for tool and cutter grinders and special machines, such as blade grinders.

Pope P-16121 10 HP motorized, heavy duty deep hole (72″ long) spindle for ID and OD grinding of large workpieces.



Pope P-5068-B High Cycle motorized spindle for grinding and milling up to 100,000 RPM; water cooled, oil mist lubricated.



Pope P-19162-AN "Anocut" electrolytic motorized grinding spindle, 1 to 20 HP; arranged to transmit from 50 up to 3000 amperes, at speeds up to 18,000 RPM.

Pope Motorized Spindles on special and automated machines assure you of continuous production of accurate parts. May we quote on your requirements?

No. 136

POPE®

ENGINEERS, DESIGNS AND BUILDS PRECISION ANTI-FRICTION BEARING SPINDLES FOR EVERY PURPOSE

POPE MACHINERY CORPORATION • 261 RIVER STREET • HAVERHILL, MASS.

Established 1920

The 1960 Golden Anniversary annual report of Norma-Hoffmann Bearings Corporation, Stamford, Connecticut, outlines the impressive progress resulting from their long range capital improvement program. By the careful selection of reliable capital equipment compatible with a comprehensive quality control system, Norma-Hoffmann customers are assured of a consistently fine quality product.

AN INDICATION OF PROGRESS AT NORMA-HOFFMANN

. . . Bryant Centalign® Grinders

Important factors in progressive statistical quality controlled production are the Bryant Model "C" Centalign Grinders shown here in the Norma-Hoffmann plant. Straight bores and precision bearing raceways are ground on the Centaligns with consistent accuracy . . . at record-breaking production rates.

Progressive manufacturers throughout the world are improving their competitive position with Bryant Centaligns. Engineered for quick changeover and minimum down time, every one is thoroughly "proved out" at Bryant by statistical quality control methods. Find out how a Centalign Internal Grinder can help you.

BRYANT

Chucking Grinder Co.

58 CLINTON STREET, SPRINGFIELD, VERMONT, U.S.A.

Internal Grinders • Special Machinery

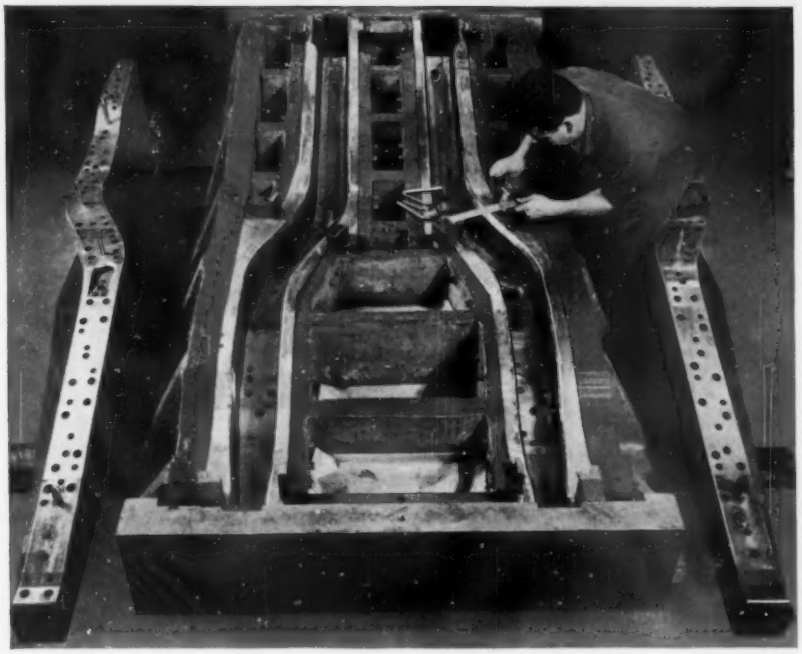
Use Reader Service Card, CIRCLE 12

Steel
for Strength
. . . Economy
. . . Versatility

Tool Steel Topics

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.



Die of AH-5 Tool Steel
Forms Sheet Steel Auto Frames

This huge die, of Bethlehem AH-5 tool steel, was made by Parish Pressed Steel Division of Dana Corporation to form automobile frames. Hardened to Rockwell C 60-62, the die handles sheet steel .120 in. thick.

Engineers at Parish like the wear-resistance of AH-5, which enables them to produce about 25,000 frames before slight redressing of the die becomes necessary. AH-5's low distortion and good shock-resistance were also singled out for favorable comment.

AH-5 is an air-hardening grade containing 5 pct chromium. It's an easy steel to machine because it can be annealed to 212 Brinell. Here's its typical analysis:

Carbon 1.00 Chromium 5.25
Manganese 0.60 Molybdenum 1.10
Vanadium 0.25

AH-5 assures economical, long-run performance from forming and blanking tools, dies, and punches. For full particulars about AH-5 or any of our other air-hardening tool steels, get in touch with your Bethlehem distributor.

• • • • •

For maximum wear use LEHIGH H

A maker of beer can openers produced several million pieces with die of Lehigh H (our AISI D-2 grade). Lehigh H provides outstanding wear-resistance in a variety of difficult applications because of its high concentration of well-distributed carbides.

It's also easy to machine. An air-hardening grade, Lehigh H has a high-carbon, high-chrome analysis.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Here Are the Facts on Clearance:

It's the Blank That Tells the Story

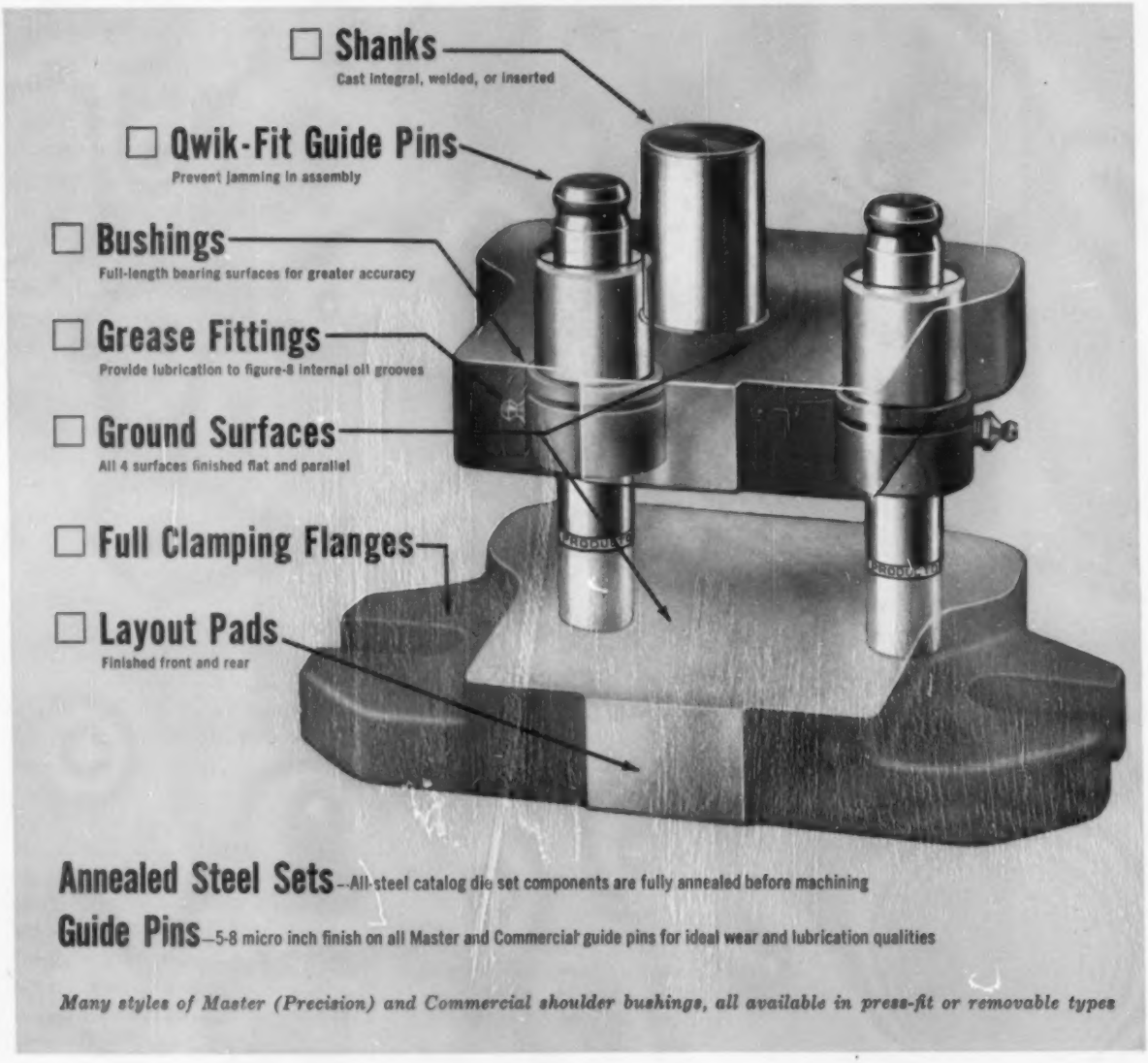
Operators of punching, blanking, and shearing equipment recognize that proper clearance between punch and die is necessary for good operation. The right amount of clearance produces the lowest cutting pressure and the least wear on the tools, and also makes possible clean, sheared edges which are free from burrs.

The most common rule for clearance is this: clearance should be about one-tenth the stock thickness. Yet in many shops there's a continual search for some "magic" formula that will more accurately determine the proper clearance . . . which in turn will automatically eliminate whatever type of trouble is current.

There is no need to wait for such a formula to be developed because it is not actually needed. Examination and evaluation of the blanks, or sheared edges being produced, will tell whether the proper clearance is being used. Sheared edges produced with proper clearance will show "shear" (the smooth, shiny portion) for about 1/5 to 1/3 the stock thickness; the remainder of the edge will show "fracture" (this is the rough, granular part). If the "shear" occupies too great a portion of the thickness, it indicates the clearance is too great; when the "shear" is too little, insufficient clearance is indicated. If heavy burrs are present on the sheared edges, and if the blanks are "cupped," then the clearance is too great. Burrs on portions of the sheared edges may indicate misalignment or dull tool edges which, in effect, change the clearance from the amount theoretically present.

Developing and maintaining proper clearance pays off in the production of high quality parts, and also results in minimum tool wear and low tool costs.

☐ Check the benefits you get in a Producto Die Set...


☐ Shanks
Cast integral, welded, or inserted
☐ Qwik-Fit Guide Pins
Prevent jamming in assembly
☐ Bushings
Full-length bearing surfaces for greater accuracy
☐ Grease Fittings
Provide lubrication to figure-8 internal oil grooves
☐ Ground Surfaces
All 4 surfaces finished flat and parallel
☐ Full Clamping Flanges
☐ Layout Pads
Finished front and rear

Annealed Steel Sets—All-steel catalog die set components are fully annealed before machining

Guide Pins—5-8 micro inch finish on all Master and Commercial guide pins for ideal wear and lubrication qualities

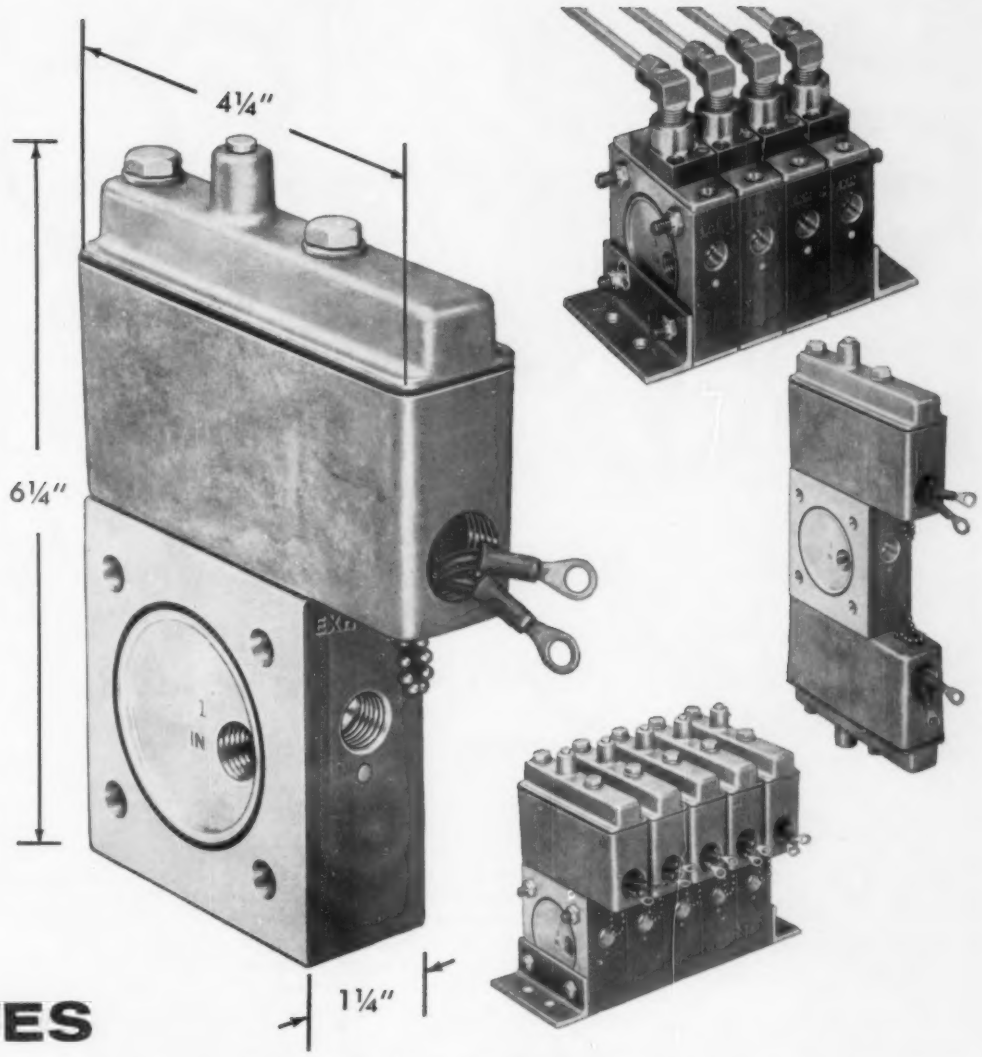
Many styles of Master (Precision) and Commercial shoulder bushings, all available in press-fit or removable types

THE PRODUCTO MACHINE COMPANY
92: Housatonic Avenue, Bridgeport 1, Connecticut

PRODUCTO

PRODUCE MORE WITH PRODUCTO PRECISION DIE SETS

SLIM LINE VALVES



• minimum space • building block design
• maximum control flexibility

Here's truly miniaturized, versatile precision control with surprisingly large flow capacity . . . Slim Line valves! Mount them singly to control clamping devices on jigs and fixtures. Or, bank them in manifolded groups of as many valves as you need, limited only by service and air requirements. Choose from 3- and 4-way types, for air, oil or water service, pressures to 125 psi, tapped ⅛ or ¼ in. NPT.

Where space is limited and you require maximum precision and versatility to control one or a virtually unlimited number of small or medium size cylinders, diaphragms, pilot cylinders, or similar devices . . . you need Slim Line valves. Ask your nearby Hunt representative for proof.

3048

For more information, write for Bulletin 612. Address Hunt Valve Co., Salem, Ohio, Dept. TE-1061.

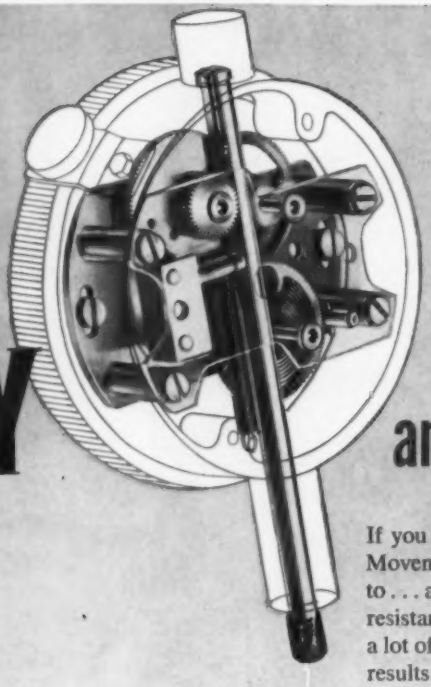
HUNT

QUICK-AS-WINK® AIR AND HYDRAULIC

VALVES

HUNT VALVE COMPANY • DIVISION OF IBEC • SALEM, OHIO

ALL VERY HAPPY



and You'll be, too!

WITH THE

MIRACLE MOVEMENT

DIAL INDICATOR

If you haven't yet discovered the Federal Miracle Movement Indicator, you have a lot to look forward to . . . as these users point out below. Its *unmatched* resistance to wear and to shock is saving money for a lot of people. Why not join them and enjoy better results than with the indicator you are now using? You will, . . . take *their* word for it!

Drastically Reduced Maintenance Costs

"We have been ordering Federal Miracle Movement Indicators for some time now, and estimate that they comprise about 50% of all the Federal Dial Indicators we have in use at the present time. Our maintenance records show, however, that the Miracle Movement Indicators comprise less than 4.3% of those needing repair. This certainly indicates an outstanding increase in the durability of your product."

The American Welding & Manufacturing Co., Warren, Ohio

Outlasts Them All

"One of our inspection jobs . . . checking the split line height of sleeve bearings . . . is a tough application for the dial indicators because they are mounted on a hydraulic ram and are subjected to heavy impact each time the ram is actuated. Federal Miracle Movement Indicators are doing this difficult job very satisfactorily at an average maintenance cost of approximately $3.00 per indicator of which only 10% is for replacement parts! With other makes, repair costs usually run about 6 or 7 times as much per indicator."

McQuay-Norris Manufacturing Co. Indianapolis, Indiana

Greater Accuracy for OEM Products

Hunter Spring Co. of Lansdale, Pa., has been using Federal Dial Indicators in their testers for many years. Because of the critical nature of the application, they had always made extensive tests and inspections of the indicators to assure the high level of performance required. The increased wear resistance and shock resistance of Miracle Movement Indicators, plus their reduced friction, has made it possible for Hunter to save on inspection costs prior to assembly of the indicator into their equipment.

Best part is . . . You don't have to pay a premium price for Miracle Movement Indicators. They actually COST LESS than other recognized makes.

You don't have to specify Miracle Movement — just specify Federal! Ask for our latest Dial Indicator Catalog.

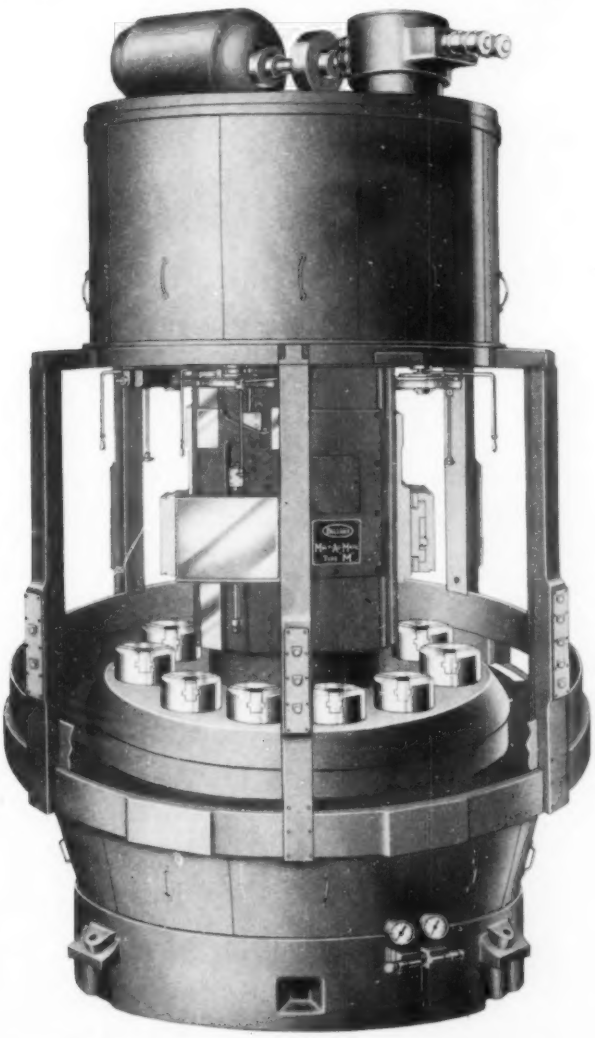
Federal Products Corp.
11910 Eddy Street, Providence 1, R. I.

Ask FEDERAL® *First*

for Recommendations in Modern Gages . . . Dial Indicating, Air, Electric, or Electronic — for Inspecting, Measuring, Sorting, or Automation Gaging

BULLARD

THE PRICE IS LOWER !
THE PRICE IS LOWER !
THE PRICE IS LOWER !
THE PRICE IS LOWER !



with the NEW Bullard Mult-Au-Matic Type "M"

To achieve the same production output obtainable from a Bullard Mult-Au-Matic, Type "M", competitive methods would require a greater investment of capital funds.

Built to exacting Bullard standards, the Type "M", available with 6, 8, or 12 spindles, incorporates in its design many features which insures its rigidity, accuracy, and productivity, even on difficult machining jobs.

For complete Mult-Au-Matic, Type "M" information, write for a catalog or call your nearest Bullard Sales Office or Distributor.

The Bullard Company, Bridgeport 9, Conn.

THE PRICE IS LOWER !

Use Reader Service Card, CIRCLE 17

Use Reader Service Card, CIRCLE 18

Quality Tools

ARE YOUR BEST INVESTMENT

CLEVELAND Tools help you reduce your tooling costs, because . . .

- Their built-in quality lowers your manufacturing costs.
- You can get CLEVELAND QUALITY in a wide range of cutting tools.
- Fast delivery from local distributors' stocks, to maintain your production schedules.

PLUS the added benefits of "Teamwork Tooling", whereby the talents of many people are combined to effectively reduce your costs. "Teamwork Tooling" includes not only our engineering skills and modern manufacturing facilities, but also the capable services of our Suppliers, Stockrooms, Service Representatives and Distributors.

THE CLEVELAND TWIST DRILL CO.
Cleveland 1, Ohio

QUALITY CUTTING TOOLS • BEST SERVICE THROUGH YOUR LOCAL DISTRIBUTOR

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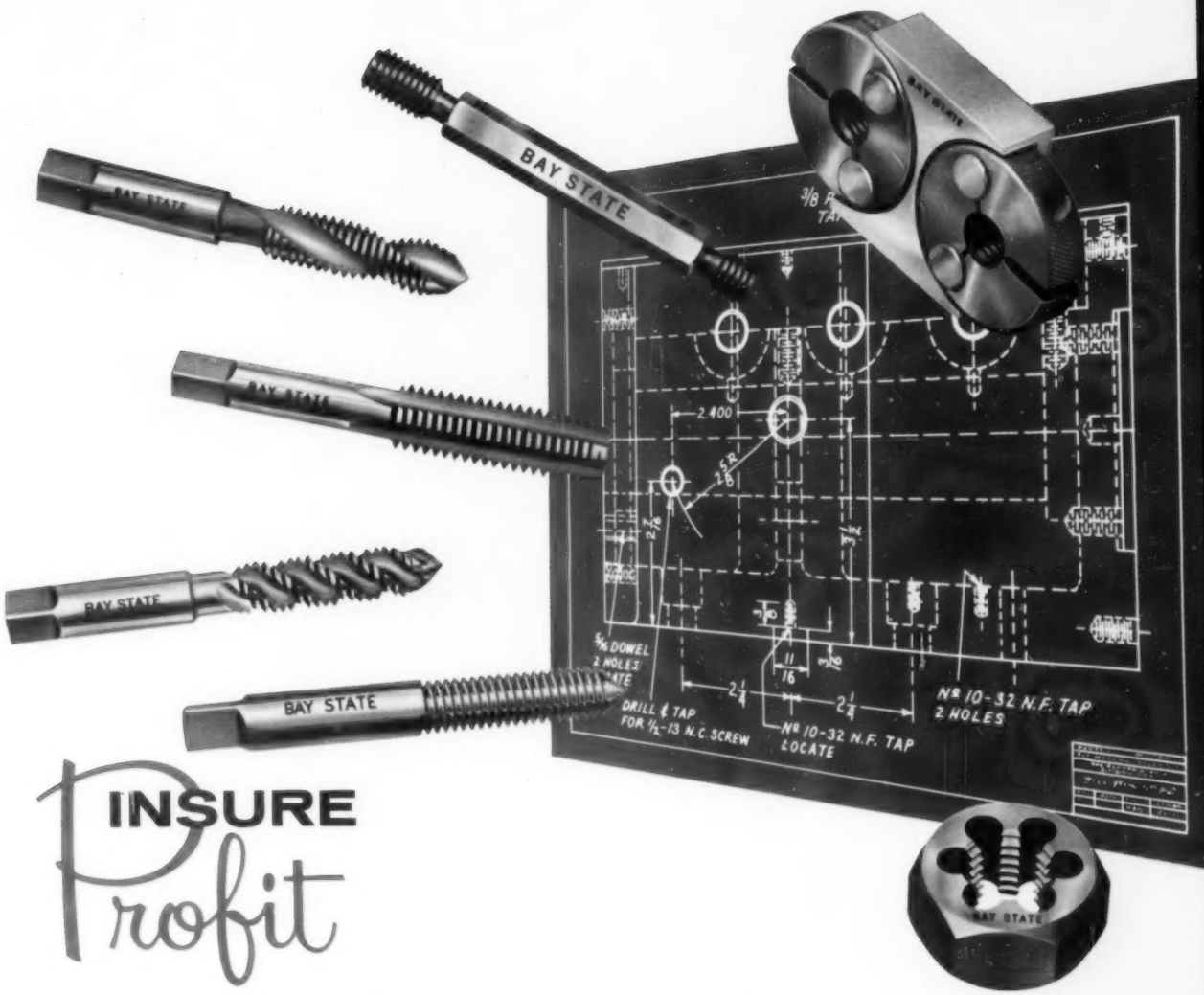

INSURE Profit

IN YOUR THREADING OPERATIONS

BAY STATE *Quality* Taps, Dies and Gages will produce your threaded parts *at lower cost*, because . . .

- Skillfully engineered and manufactured to give you *more threaded parts per tool.*
- A complete line of Taps, Dies and Gages for all threading operations.
- Prompt service from your local Industrial Supply Distributor.

PLUS our trained Service Representatives operating out of strategically located stockrooms to help you solve your thread cutting and gaging problems.

BAY STATE TAP AND DIE CO.
Mansfield, Mass.

Subsidiary of The Cleveland Twist Drill Co.

QUALITY BAY STATE CUTTING TOOLS • BEST SERVICE THROUGH YOUR LOCAL DISTRIBUTOR

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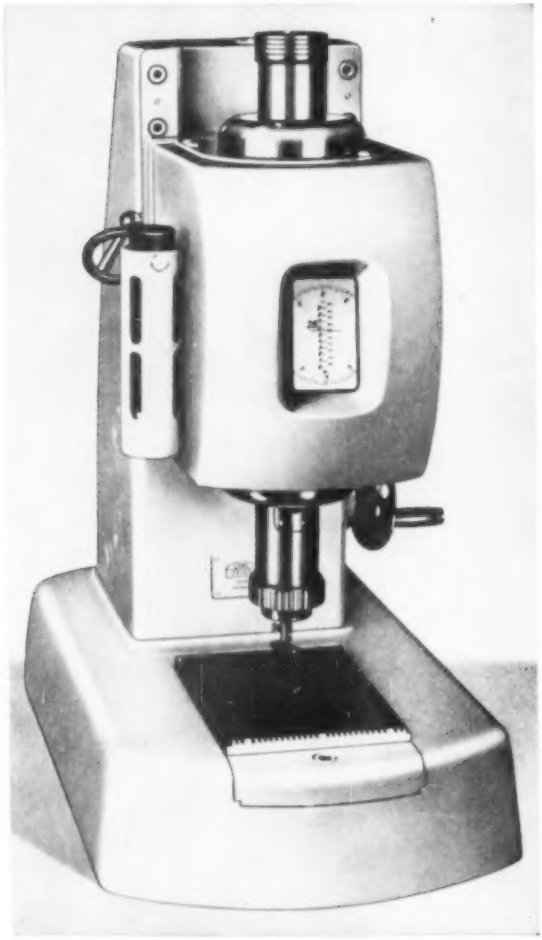
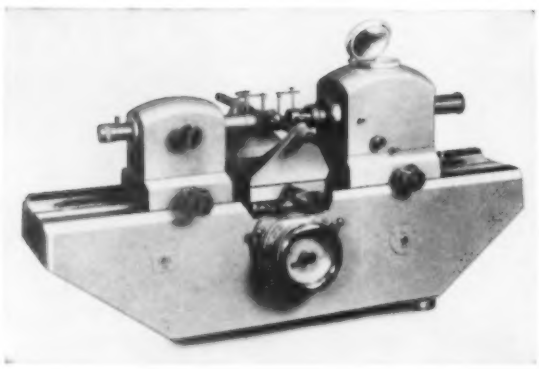
Speedy, convenient thickness meters by CARL ZEISS

WEST GERMANY





Vertical Metroscope

With this instrument of advanced design, direct precision measurements of heights and outer diameters can be made of parts having parallel, cylindrical, spherical surfaces, and threads (pitch diameter by the 3-wire method).

Measurements are carried out with the operator seated conveniently in front of the instrument. Low positioned, insulated switch handles prevent the transfer of body heat of operator when manipulating it, thereby assuring highest reading accuracy. Motor drive affords utmost ease in raising and lowering measuring spindle, and in adjusting the reading device.

Spindle has a 4″ glass scale, the image of which is projected into a $1\frac{3}{4}$x$3\frac{1}{4}$″ window at a magnification of 46x. Permits convenient readings direct to .000050″, by estimation, to .000010″.

Measuring table is $6\frac{11}{16}$x$5\frac{1}{8}$″ and has two working surfaces. One side is grooved for general measuring, while the other side has three ribs for gauge-block measurements. Auxiliary tables may be screwed into the grooved side for measuring balls, sheet metal, foil, turned parts with shoulders, etc., and for thread measurements.

Measuring unit affords a total working range of up to 8″.

Horizontal Metroscope

A universal measuring instrument for lengths up to 24″. Used for the determination of inside and outside diameters, inside and outside pitch diameters, etc. Projected scale image permits convenient readings direct to .000050″, and by estimating, to .000010″.

Write for literature.

CARL ZEISS, INC.

485 FIFTH AVENUE, NEW YORK 17, N. Y.

COMPLETE SERVICE FACILITIES

LECTRA-FORM
Increases Production 500%

Ex-Cell-O Model 244 machines recess 5 times faster, with far lower tool cost!

Ex-Cell-O LECTRA-FORM Machines remove metal through high-current, low-voltage electrical spark discharge. Producing an inverse image of low-cost shaped rod, tubing or sheetmetal tooling, LECTRA-FORM accurately drills, pierces, trepans, slots, cuts or sinks intricate cavities in carbides and other conductive materials difficult or costly to machine by other methods.

Contact your Ex-Cell-O Representative for details, or write for LECTRA-FORM Bulletin 436014.

Model 244 has an electro-hydraulic servo for automatic tool feed and gap control, removes metal without distortion due to tool pressure. Inset photo shows part before and after 8-minute LECTRA-FORM machining.

HERE'S HOW LECTRA-FORM COMPARES TO CONVENTIONAL MACHINING

WORKPIECE Nickel-alloy aircraft part*	LECTRA-FORM MACHINING	FORMER METHOD
Tooling	Low-cost brass rod	Small end-mill cutter
Tool cost	Negligible	High wear and breakage
Accuracy	Uniform wall thickness	Distorted wall contour
Machining time	**8 minutes**	**40 minutes**

*Depth of recess approx. .080", wall thickness approx. 1/32".

61-30M

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

MIKRON TYPE 21/0

HYDRAULIC GEAR HOBBING MACHINE

precision **PLUS** *production*

"THREE MACHINES —one basic unit"

1. HAND LOADING
2. SEMI-AUTOMATIC MAGAZINE LOADING
3. FULLY AUTOMATIC HOPPER LOADING

FEATURES:

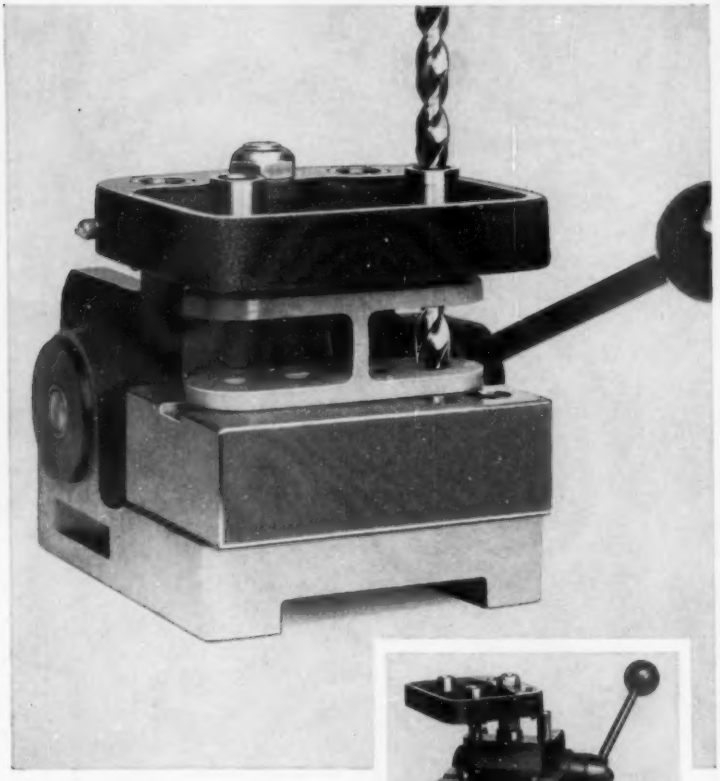
- Infinitely variable hydraulic feeds
- Automatic box type hob cycle...no hob approach
- High spindle speeds...4800 rpm maximum
- High production rates
- AGMA Class III precision accuracies possible
- Centralized lubrication
- Automatic part deburring
- Low cost tooling
- Simplicity of set-up and quick change-over

RUSSELL, HOLBROOK & HENDERSON, INC.

292 MADISON AVE.
NEW YORK 17, N. Y.

2840 SUPPLY AVE.
LOS ANGELES 22, CAL.

Another production time-saver from Ex-Cell-O . . .



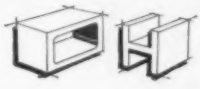
LIFT-SWING: the answer to tough drilling jobs!

Available in a range of sizes for short-run and volume drilling, reaming and tapping, Ex-Cell-O's new Lift-Swing Drilling Fixture loads and unloads in seconds, and is precision-machined for 90° "tumble-jig" setups.

Patented "swing-away" top plates swivel for access to the part, and permit a variety of easily tooled jobs; double top plates let you drill stepped holes, or adjacent holes with minimum wall thickness, regardless of bushing wall size.

Your local Ex-Cell-O Representative or Distributor will gladly show you how low-cost Lift-Swing Drilling Fixtures save tooling time and fixture costs, or contact Ex-Cell-O direct for details: Phone TOwnsend 8-3900; TWX—DE 876; Wire ZTC.

COMPONENTS FOR ALL YOUR JIG AND FIXTURE NEEDS— AVAILABLE IMMEDIATELY FROM A SINGLE, RELIABLE SOURCE!



Micron Sections— Machined cast-iron shapes cut to order.

Drill Jig Bushings— Carbide or steel for metal and plastic jigs.

Fixture Components— Clamp assemblies and fixture details.

Reader Service Card Number is for Lift Swing literature only. Request literature on above items separately.

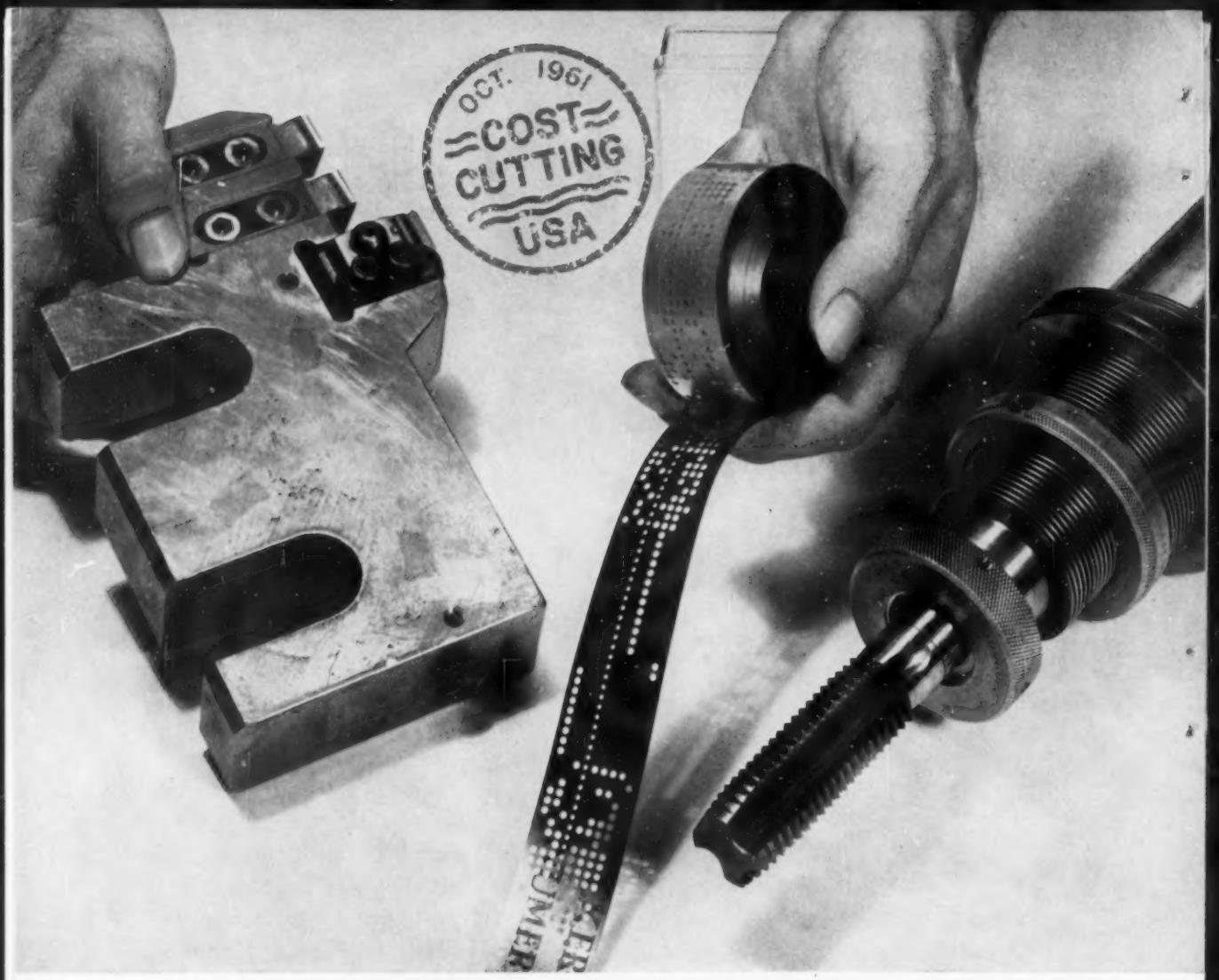
61-50 BU

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Bushing Sales Division

EX-CELL-O CORPORATION DETROIT 32, MICHIGAN



ECONOMICALLY: (*No difference between tape and these tools for automatic chuckers*)

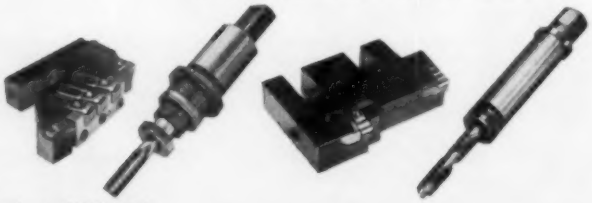
These new tools can cut your change-over time on automatic chuckers 50 to 75%. They provide the same ECONOMIC benefits as numerical control. Setup procedures and dimensions are programed on layout drawings. All cutting tools are preset accurately in bench gages while your machine is running. The first piece produced after setting up is an accurate one. The toolholders are clamped or chucked in the machine hydraulically. Job information is "stored" in layout drawings. Repeat jobs can be set up and running in 30 minutes. This means it is now economical to put short-run jobs on automatics — reduce your lead time and parts inventory. Inventory — the magic word in cost cutting. ANNUAL COST of inventory is 18 to 25% of its value. So if you produce a lot of different parts on turret lathes and single-spindle chuckers, here's a proved new method of saving money.

Scully-Jones and Company

1915 South Rockwell Street, Chicago 8, Illinois

SCULLY JONES

QUICK-CHANGE
QUICK-SET TOOLING



Tools can be inserted in only two and one-half minutes.

Use Reader Service Card, CIRCLE 24

DO YOUR OPERATIONS DEMAND ACCURATE CENTERS?

Ex-Cell-O Center Lapping Machines Increase Accuracy, Reduce Scrap!

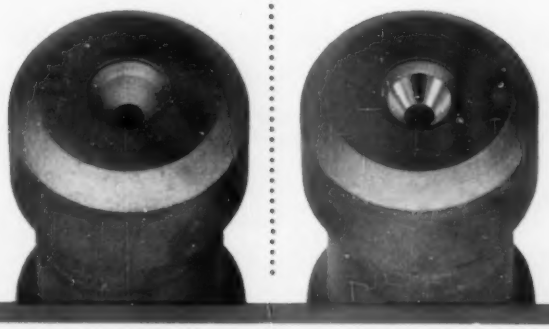
Precision Center Lapping Machines remove heat-treat scale, and eliminate roughness and distortion of centers to insure accuracy in subsequent operations.

Easy to use and modestly priced, Center Lapping Machines include as standard, inbuilt equipment Ex-Cell-O Precision Spindle and manual diamond dresser.

See your Ex-Cell-O Representative, or write for Bulletin 40271.

BEFORE LAPPING

- Out of line
- Out of round
- Incorrect angle
- Rough or torn



AFTER LAPPING

- Perfect alignment
- True roundness
- Precise angle
- Mirror-smooth

60-37

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

Namco DBS Vers-O-Tool gives...
50 times more pieces per grind

...for Stevens Manufacturing Company *

When Stevens Manufacturing Company, Lexington, Ohio equipped a Brown & Sharpe No. 2 automatic with a NAMCO ⅜" DBS Vers-O-Tool, the increased threading efficiency was astonishing. On the part shown, pieces-per-grind soared from an average of 1000 to 50,000; scrappage dropped 90%; production increased by 2½ times; tolerance trouble became a thing of the past. Stevens finds such performance typical for the DBS. A non-revolving threading tool, it's designed specifically for B & S automatics; has an exclusive automatic opening and closing mechanism for unmatched precision in cutting close-to-shoulder threads. Available capacities are shown below. Thousands of manufacturers use NAMCO threading tools to slash threading costs and improve thread quality. Our 44 page bulletin DT-60 will give you all the details. Get in touch. We'll be happy to send you a copy.

Size Die Head Inches	Brown & Sharpe Machine Size‡	Straight Threads		Adjustment for Diameter		Capacity Pipe Threads Inches	Coarsest Standard Pitch
		Min. In.	Max. In.	Minus	Plus		
DBS ¼	No. OO-O-OOG-OG	.056	¼	.031	.004	⅛	18
*DBS ⅛	No. O-OG-2	⅛	⅜	.071	.012	⅛	16
†DBS ⅝	No. 2	¼	⅝	.068	.020	¼	11

*Chasers and blocks interchangeable with ⅛" DR and ⅛" DS die.
†Chasers and blocks interchangeable with ⅝" DR and ⅝" DS die.
‡And corresponding BSA sizes. Larger capacity Vers-O-Tools for B & S and BSA machines can be furnished on application.

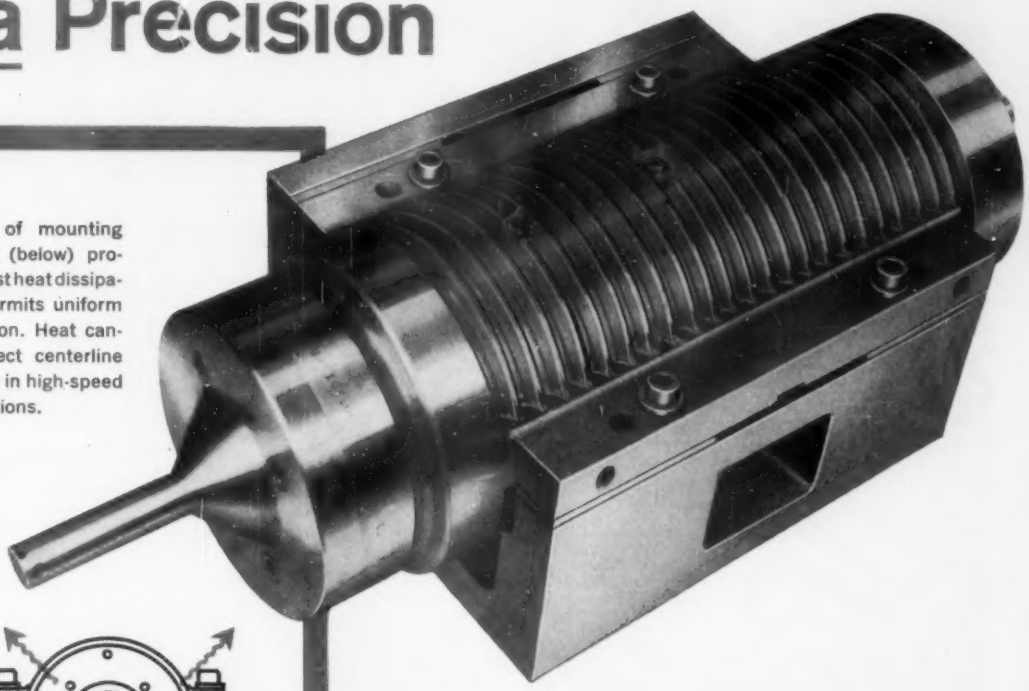
*Aluminum expansion tube for Stevens Type H adjustable thermostat. Thread specifications: class—2; pitch—56, diameter—5/16", length—1 11/32", tolerance ±.010 (actual size)

National Acme

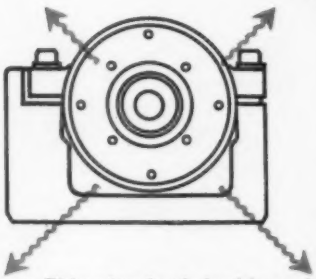
THE NATIONAL ACME COMPANY
193 E. 131st STREET
CLEVELAND 8, OHIO

Sales Offices: Newark 2, N. J., Chicago 6, Ill., Detroit 27, Mich.

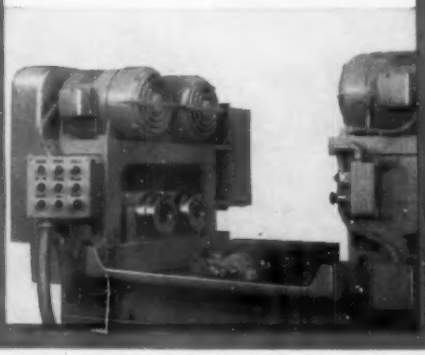
NEW Ex-Cell-O Spindles for Ultra Precision



Design of mounting bracket (below) provides fast heat dissipation, permits uniform expansion. Heat cannot affect centerline position in high-speed applications.



Below: This standard double-end Ex-Cell-O Precision Boring Machine provides a steady platform for the ultra-precision boring job described at right.



The special spindle shown above is one of 16 identical Ex-Cell-O Ultra Precision Boring Spindles recently developed for an extremely demanding boring operation.

Customer specifications called for a guaranteed maximum allowable .00003″ on roundness, with a 10 RMS or better surface finish. The spindles Ex-Cell-O delivered have consistently held .00002″ on roundness, with a 6 micro-inch surface finish (and the customer has ordered duplicates)!

Why do the new Ultra Precision Spindles and other standard and special Ex-Cell-O Boring and Grinding Spindles give consistently greater accuracy, finer finishes and longer, trouble-free life?

The answers are: Engineering and production experience (more than 40 years); exclusive design and construction (using famous Ex-Cell-O Spindle Bearings); and job-tailored availability (Ex-Cell-O offers the most comprehensive line of belt-driven, air-driven, motorized and high-frequency spindles available today).

Need fast delivery of Precision Spindles for original equipment or replacement use? Call your Ex-Cell-O Representative today, or contact Ex-Cell-O in Detroit.

60-85

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS GAGES AND SAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION

DETROIT 32, MICHIGAN

New—
CARMET'S 700 Series Cutting Grades and the fine art of making chips

Some people baby their carbide tools. They hold back a little on roughing cuts, because they've heard carbide is pretty brittle . . . and some of it is. Or they ease off on finishing cuts, because their tool may be too soft for long, fast passes . . . because it may wear or crater. And, some of it will.

But this is "paring-knife" machining, and it really isn't necessary. Not any more . . . not since Carmet introduced the 700 Series Steelcutting Grades. No paring knife made these chips . . . these were hogged out on a production basis by one of Carmet's new carbides . . . Grade CA-720.

The job: rough facing railroad axle forgings in an automatic tracer lathe—210 sfm—.076" feed—1¼" width of cut. The result: over 1,000 cubic inches of steel removed in 5½ minutes, floor to floor, with plenty of red hot chips like these. And, 35 axles per tool against 25 pieces for the best competitive carbide tool . . . a tool carrying a higher price tag.

Carmet's 700 Series have the edge wear and crater resistance, *and* the ability to endure shock and heat, to breeze through jobs like this. They're doing just that all over the country . . . right now! Next time you're setting up a mean, tool-buster of a cut, let the 700 Series make chips and money for you, just once. Your Carmet Distributor has the local stock and all the information. Call him, or write:
Carmet Division, Allegheny Ludlum Steel Corporation, Ferndale, Detroit 20, Michigan. Dept. TE-10-1.

CARMET® AL

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3532

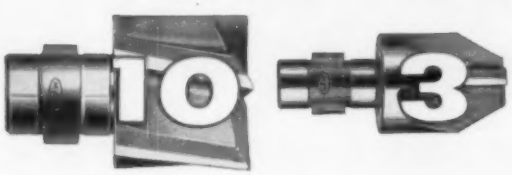
NOW A Continental Counterbore Set for New Standard Socket Head Screws!

Designed especially for the stronger, safer 1960 Series socket head cap screws, the Continental No. 1B Standard Toolroom Set provides a wide range of sizes in a cost-saving, space-saving tool set.

Supplied in a sturdy, fitted oak box, and equipped with a complete lineup of tools in the most-used sizes, the No. 1B gives you traditional CTW quality and performance for toolroom or job shop counterboring, spot-facing and countersinking operations.

Call your local Ex-Cell-O Representative, or contact Continental Tool Works for details on the full line of CTW Counterbore Sets, and standard and special cutting tools and broaches.

STANDARD TOOLROOM SET NO. 1B CONTAINS:



- 10 hand-detachable CTW Counterbores for #6 through ⅝" dia. screw heads.
- 3 self-centering, hand-detachable CTW Countersinks.

- 17 hardened and ground counterbore pilots.

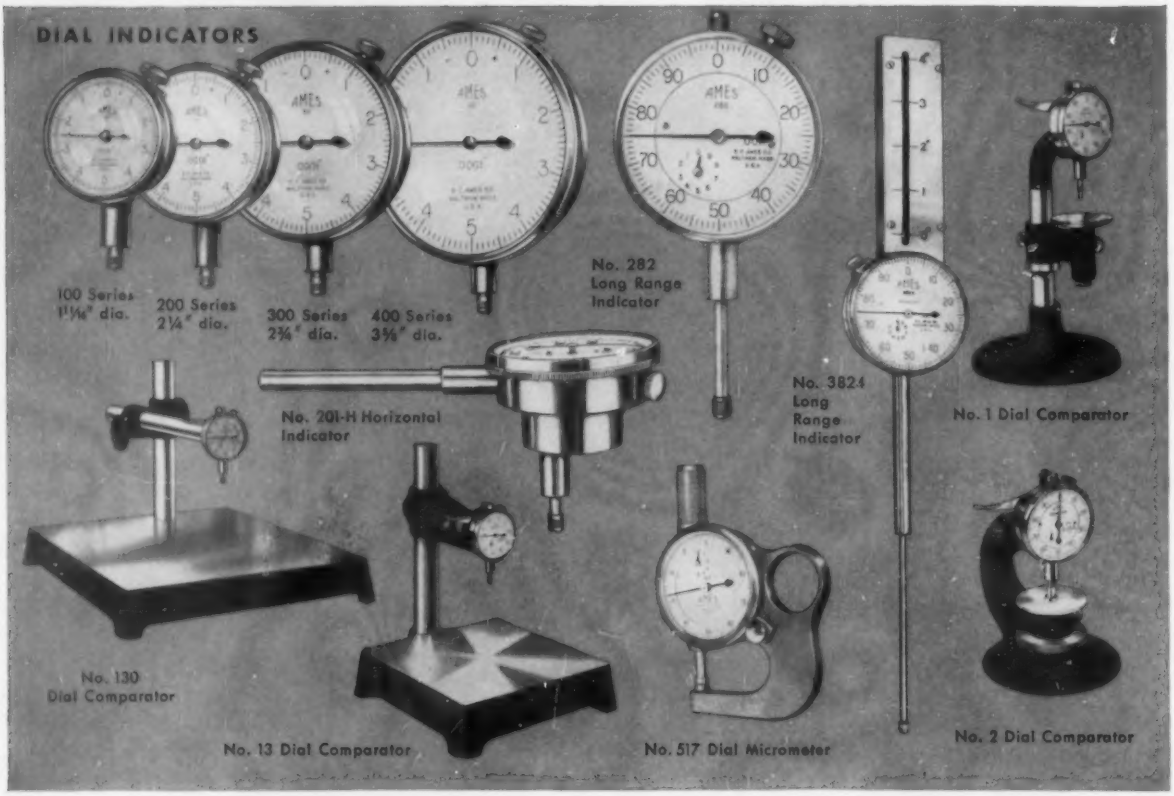
- 2 CTW Holders with non binding, "twist of the wrist" release action. (Available with Morse taper or straight shank.)

"No one has ever reported failure of a Continental Counterbore Drive!"

60-60

Continental CTW TOOL WORKS DIVISION OF EX-CELL-O CORPORATION DETROIT 32, MICHIGAN

AMES *Masters of Measurement*


DIAL INDICATORS
100 Series 1 1/16" dia.
200 Series 2 1/4" dia.
300 Series 2 5/8" dia.
400 Series 3 5/8" dia.
No. 282 Long Range Indicator
No. 3824 Long Range Indicator
No. 1 Dial Comparator
No. 201-H Horizontal Indicator
No. 130 Dial Comparator
No. 13 Dial Comparator
No. 517 Dial Micrometer
No. 2 Dial Comparator

DIAL INDICATORS AND GAUGES

Use Them for Checking: taper, height, depth, flatness, roundness, straightness, thickness, diameter, length and size.

Features Include: easy-to-read dials, unbreakable crystals, forged cases, backs and wheel support, contour-lapped pinion teeth.

Attachments: rubber and metal dust guards, long stem indicators, tolerance hands, lift levers, special backs, contact points, etc.

For literally hundreds of measuring, indicating and comparing operations, you'll find Ames standard and customized gauges and indicators unerringly accurate and amazingly durable . . . *You're asking for the best when you specify Ames!*
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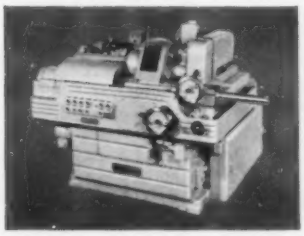
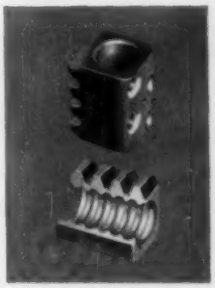
THREAD GRINDING COSTS TOO HIGH?

Here's How a Modern Ex-Cell-O can Increase Production and Lower Your Labor Costs

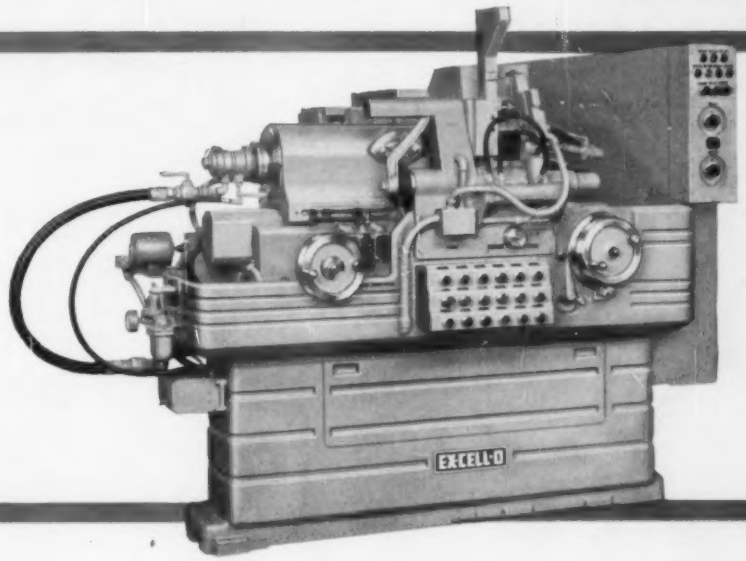


1939—Style 39 Ex-Cell-O Internal Thread Grinder, then the fastest of its kind, produced 17 automotive steering gear ball races per hour. It had power wheel dresser, automatic dresser compensation and automatic wheel feed.

1946—The part's the same, but the manufacturer has turned to a postwar Ex-Cell-O Style 39-A Precision Thread Grinder with fully automatic grinding cycle, including automatic wheel dressing at predetermined intervals. Operator simply loaded the part, reset the size handwheel and pressed the start button. Production increased to 24 parts per hour.



1960—Modern Style 39-A, today produces the same basic part but now at a rate of nearly 60 parts per hour. This powerful, versatile machine has a high-speed workhead, high-frequency Bryant Grinding Spindle, automatic loading, unloading and cycling. It requires only the part-time attention of one unskilled operator.



TOMORROW—Will you have a similar long-run part, or perhaps pinions, worms, taps, thread gages, lead screws, missile components or other special parts that cannot be rough- or finish-ground economically on your present equipment?

Your local Ex-Cell-O Representative can show you how modern Ex-Cell-O Precision Thread Grinders can substantially reduce the cost of producing a wide variety of your large and small threaded parts. Call him today, or write direct for details on the complete line of Ex-Cell-O Internal, External and Universal Thread Grinders for every toolroom and production job.

60-35

EX-CELL-O FOR PRECISION

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Machinery Division

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DETROIT 32, MICHIGAN

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Plastic mold steels

a grade for each specific mold requirement!

MC (Mold and Cavity)

Supplied annealed—or heat treated to 300 Brinell with high core hardness even in sizes to 20 x 10 inches. When carburized and oil quenched, provides high surface hardness.

Ni-Mold

A low carbon, chrome-nickel steel for cavity work when carburized surfaces are desired with exceptionally high core toughness.

Speed-Cut 300

Free machining, medium-carbon steel preheat-treated to 300 Brinell. Recommended for mold parts such as backing plates, cavity plates and spacer blocks.

Hotform V

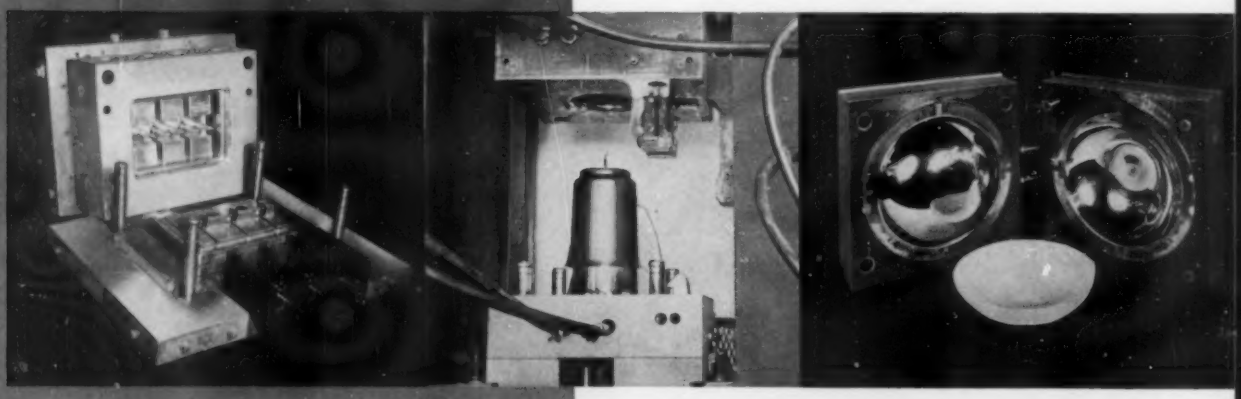
New improved Hotform "V" resists high temperatures, chromium plates with ease, is ideal for compression molding of silicone resins, etc., and long injection runs of nylon or corrosive vinyls.

Colonial No. 6

Manganese, oil hardening—closely retains size and shape after tempering. Low hardening temperature, good machinability, excellent for long runs in small cavities, either injection or compression.

Air Hard

Deep air hardening, non-deforming, good resistance to abrasive wear—valuable for compression, transfer or core molding. Intricate or complicated shapes call for this maximum-stability steel!



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EX-CELL-O

Contour Projector Used To Aid Nuclear Research

Engineers for the Enrico Fermi Atomic Power Plant used an Ex-Cell-O Model 30 Contour Projector to determine the maximum load that could be applied to a "dimple"!

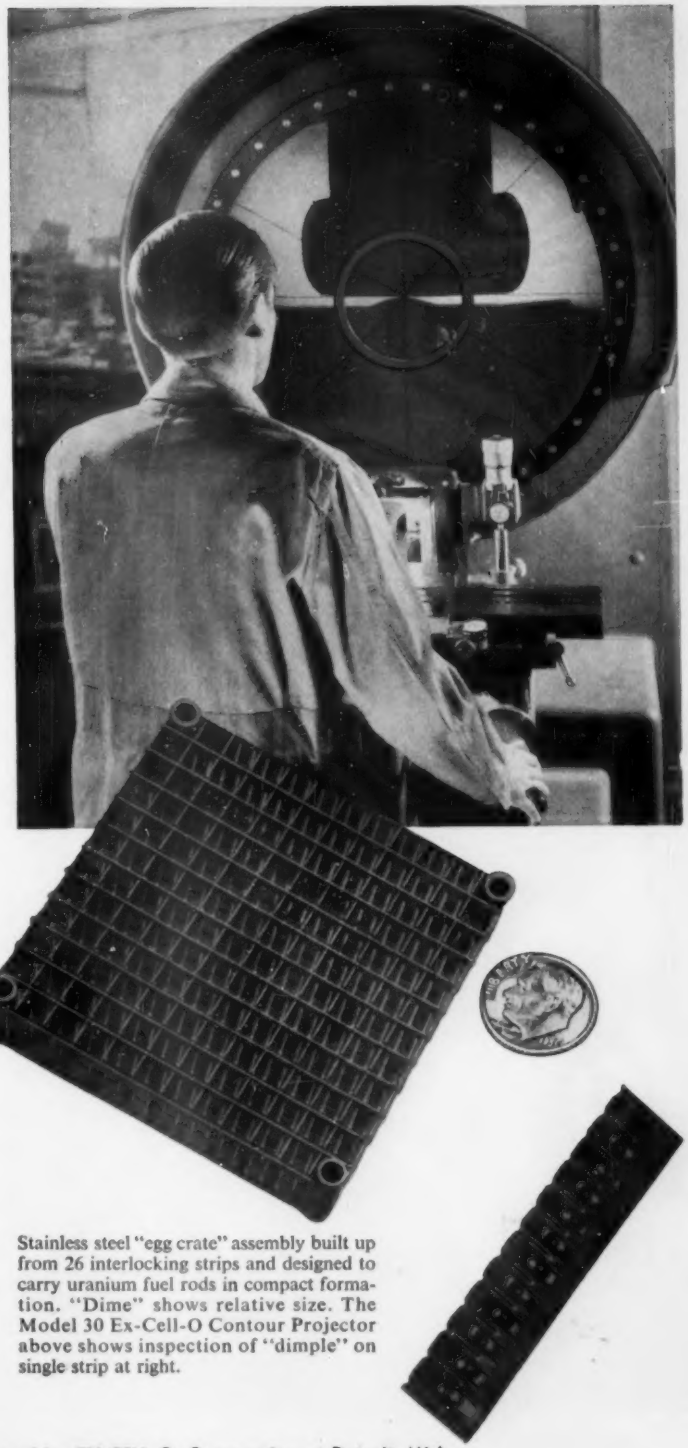
The uranium rods comprising the fuel elements in a reactor core are held vertically in "egg crate" assemblies. Each strip contains precision stamped "dimples" to provide necessary support and accurate alignment.

> *The problem was how to determine the maximum load that could be applied to these "dimples" before permanent set took place.*

Simple with an Ex-Cell-O Model 30 Contour Projector! The workpieces were mounted in a holding fixture and stress applied in increments of one pound. Under 100X magnification the deflection in movements of .0001 inch or less was easily seen on the projector screen! With the highly accurate vertical measuring micrometer and dial indicator, standard on the Ex-Cell-O Model 30 Contour Projector, the actual deflection was measured and recorded with great precision! Successive readings were plotted up to and including the yield point.

This is not an unusual inspection application for Ex-Cell-O Contour Projectors. They are helping in hundreds of different ways to speed production and bring about greater accuracy in the fields of electronics, nuclear research, and travel in space!

If you have similar difficult inspection problems . . . if your inspection is taking too much time . . . or if you need greater accuracy . . . an Optical Gaging Products man can help you. We will gladly send you our new booklet "43 Reasons Why Ex-Cell-O Contour Projectors are the First Choice of Industry."



Stainless steel "egg crate" assembly built up from 26 interlocking strips and designed to carry uranium fuel rods in compact formation. "Dime" shows relative size. The Model 30 Ex-Cell-O Contour Projector above shows inspection of "dimple" on single strip at right.

Manufactured by EX-CELL-O Corporation at Detroit, Mich.

SOLD AND SERVICED BY

CP61-3

OPTICAL GAGING PRODUCTS, INC.

26 FORBES STREET ROCHESTER 11, N. Y.

Subsidiary of EX-CELL-O Corporation

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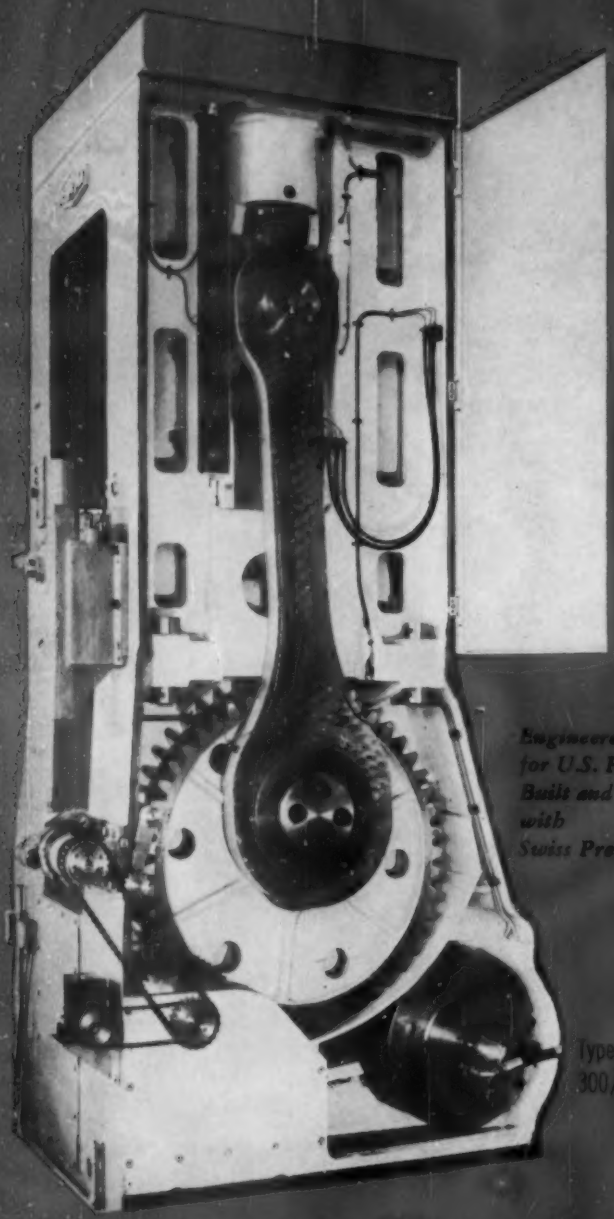
COLD FLOWING BY MAYPRES



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Type MKR 300/20-32

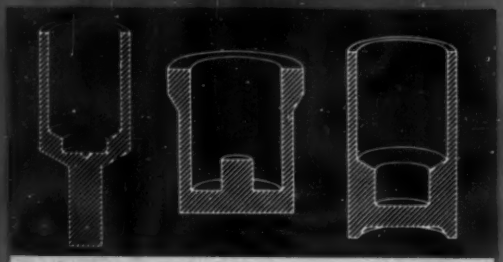
Type MKR 1-63/6

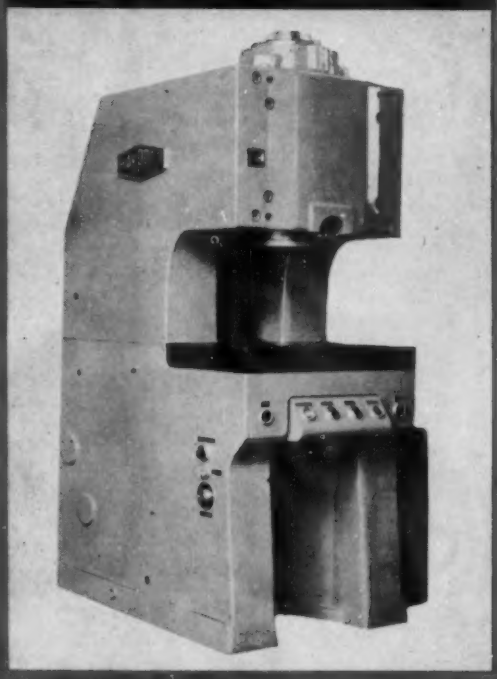
Especially designed and developed

TO COLD IMPACT EXTRUDE

steel, copper, aluminum and allied alloys.

Increases tool life . . . offers top and bottom knock-out . . . better flow motion. Incorporates all the essential features needed for cold impact extrusion.





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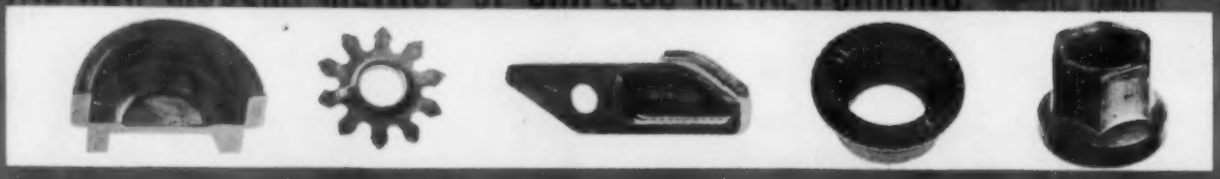

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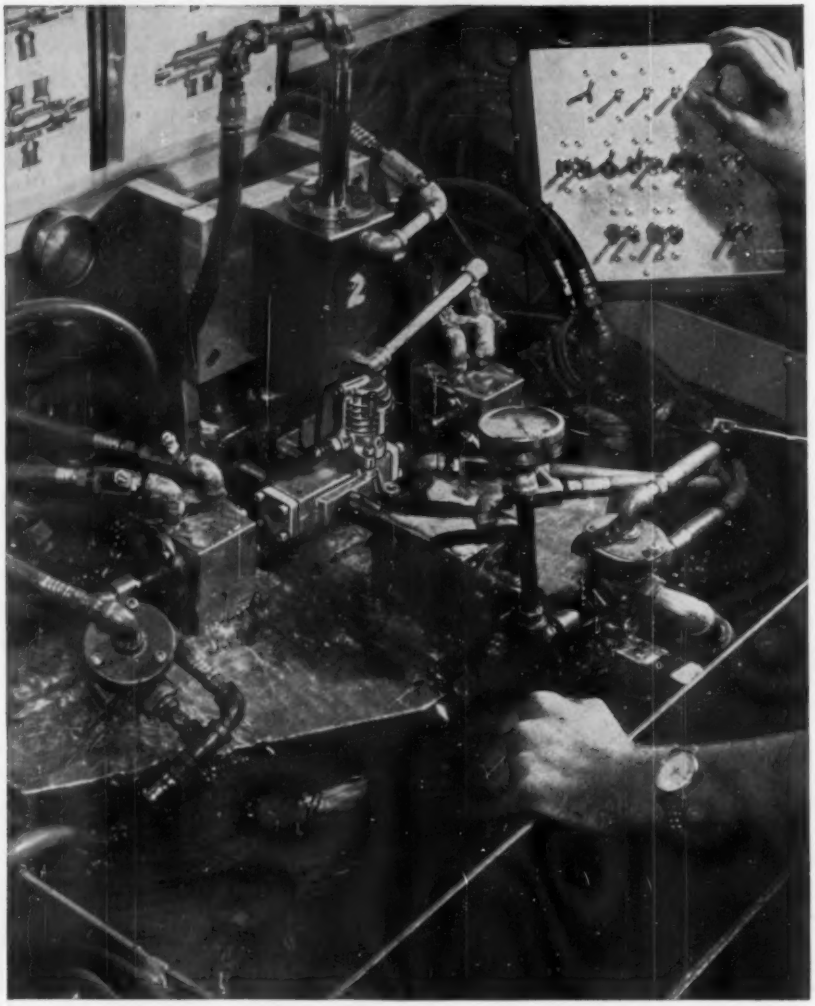

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Valvair does! How else can any manufacturer be sure that every valve he ships to a customer will function properly, from the first cycle on?

Each Valvair valve is cycled and re-cycled under water, at 30 to 50% above its rated pressure, to be certain that it meets Valvair's rigorous performance specifications. And, this final operating test is just one of the countless rigid quality control inspections each part of every valve must pass during its manufacture. In fact, one out of every twelve Valvair production men is a full-time inspector. Parts are scrutinized in process, as well as just prior to assembly. The most modern types of equipment, including optical comparators, surface finish indicators, optical and air gaging units, super magnifiers and precision gages, are used by the inspection team to assure Valvair's reputation for outstanding quality.

Specify Valvair components for the equipment you design, build or operate, to maintain your reputation for quality. For all the facts, write for Bulletin 59-SK, or call your nearby Bellows-Valvair Field Office. Address Bellows-Valvair, Akron 9, Ohio, Dept. TE-1061.

Bellows-Valvair
AKRON 9, OHIO
DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

8171

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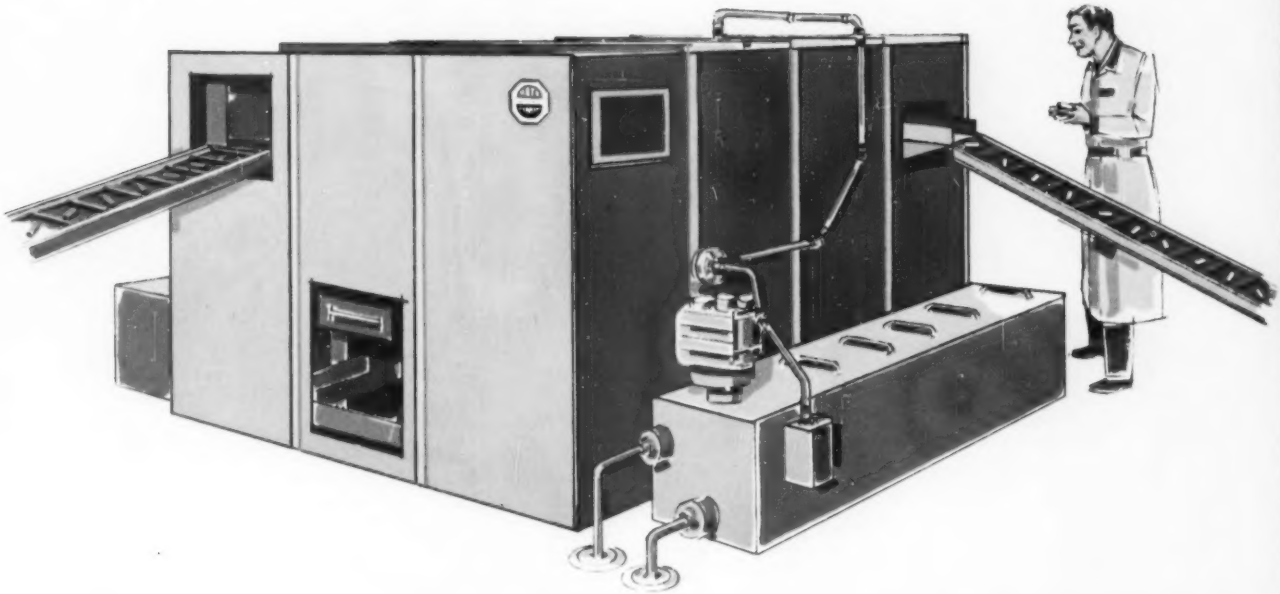
Automatic continuous or automatic batch-type finishing can be yours with the NEW

AUTOMATIC VIBRATRON®

by ROTO-FINISH/RANSOHOFF



See the Automatic Vibratron in operation at the Detroit Metal Show, Booth 1120. October 23-27

ROTO FINISH

IN LARGE PLANTS OR SMALL PLANTS, *for continuous production or batch-type production, this new* ***automatic*** *system cuts finishing costs.*

Eliminate direct labor. Reduce compound and media cost. Simplify materials handling, and improve quality . . . with the New Automatic Vibratron. You can place this machine ***anywhere*** *in your production line.*

Read How It Does More Work In Less Time At Lower Cost

BIG SAVINGS in Automatic Finishing Are Now Possible with the New

AUTOMATIC VIBRATRON®

For complete production flexibility, the Automatic Vibratron is available in two basic types, the Batch Automatic for batch production, and the Continuous Automatic for continuous production. Each is available in a complete range of sizes and capacities.

BATCH-TYPE AUTOMATIC VIBRATRON

This revolutionary design eliminates direct labor. Can be integrated with existing production equipment *anywhere in the plant.* The only facilities required are electric power, water, and your plant drain. Parts are introduced to the machine, processed, and separated *automatically.* Are fed to the machine by tote box, conveyor, or accumulating hopper. Machine cycling is timer sequenced.

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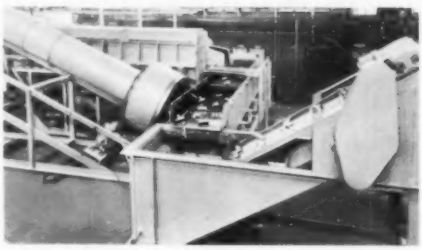
The Continuous Automatic Vibratron finishes parts on a continuous through-feed basis. No operator is required. Any process, or combination of processes can be provided. Media re-sizing, rinsing, compound recirculation, parts separation, and drying are *all automatic.*

Automatic Vibratrons are now deburring automotive transmission valves . . . preparing zinc die castings for electrostatic painting . . . finishing golf club heads for plating . . . deburring complex, 14" long die castings . . . and final finishing precision rollers for bearings to 4 micro-inch smoothness.



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VIBRATRON IS A REGISTERED TRADEMARK OF THE ROTO-FINISH COMPANY. FOREIGN AND DOMESTIC PATENTS APPLIED FOR.

ROTO-FINISH/RANSOHOFF
3700 MILHAM ROAD
KALAMAZOO, MICHIGAN

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(indicate part to be finished)

It is made of _____.
(type of metal or material)

NAME _____ TITLE _____

FIRM _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

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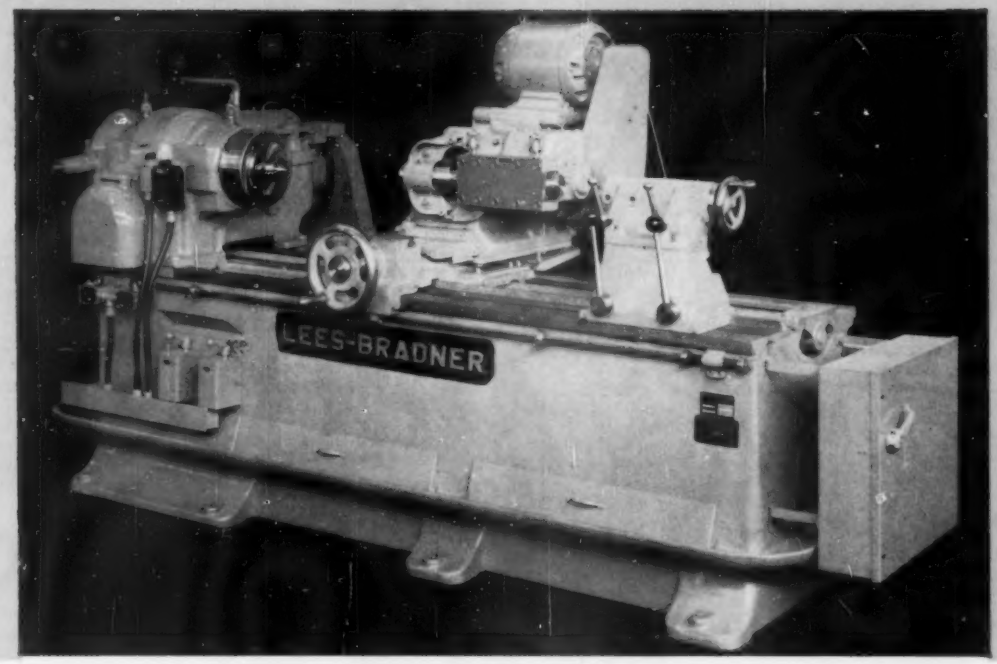
This WORM...

will turn better...thanks to...

THE LEES-BRADNER HT



Building precision into other machine tools is the unique distinction that can be claimed for The Lees-Bradner Model HT Thread Milling Machine.

The worm illustrated above was produced on this machine by the Cleveland Worm and Gear Co. in one hour 23 minutes at a cutter spindle speed of 61 R. P. M. The pitch diameter of the worm was 3.728" with an outside diameter of 4.625".

Many tough thread milling problems like this have been, and are being, solved by this remarkably versatile machine.

Contact us or your local Lees-Bradner representative for complete information on fast, precision threading with the Model HT Universal Thread Milling Machine.

Details on Worm Gear Production

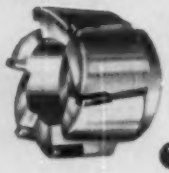
Hob Spindle Speed	61 R. P. M.
Circular Pitch	1.420"
Pitch Diameter	3.728"
Outside Diameter	4.625"
Threading Time	1 hour 23 min.
Material	2315 Steel
Weight of Worm	51.76 lbs.

IMPROVING GEARS... FOR 50 YEARS!

the LEES-BRADNER Company

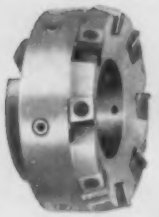
CLEVELAND 11, OHIO, U.S.A.

MILLING CUTTERS FROM Super



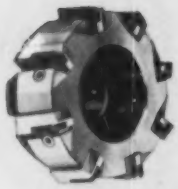
Every Milling Cutter produced by the Super Tool Company is made of high quality heat treated steel. This assures longer tool life, greater wearing ability and more diversified usage. The carbide tips either brazed or mechanically held assure faster cutting and superior finish for your product

1 **IBH FACE MILL** — The body of this face mill is designed for general all-purpose milling on any material. The solid Carbide blades are interchangeable for right or left hand bodies.



2 **SHELL END MILLS** — These End Mills utilize a special body casting and carbide tips, brazed and ground at the right angles for all applications. Super Tool End Mills are job proven through performance in hundreds of leading plants throughout the country.

3 **ROTO-BLADE FACE MILLS** — Roto-Blade Face Mills feature a new simple, practical design utilizing precision ground throw away inserts. They are built for the most rugged operations and, like the IBH mill, the wedge is placed behind the insert to insure safety for the cutter body. New cutting surfaces are available eight times by indexing and without the need for grinding. The rotateable back-up ring allows for a new insert seat after wearing without further grinding.



4 **LIST "DBS"—"DBSS" SHELL END MILLS** — These End Mills feature replaceable inserted blades in a shell end mill design. The blades, which are relatively inexpensive, can be purchased separately rather than replacing the entire cutter. The body is made of special steel alloy, heat treated for maximum strength.

5 **SLITTING SAWS** — These saws are used for cut-off, slotting, and parting of all materials in use today. Each saw is made with a heat treated steel alloy body and straightened to precision tolerances. A full range of styles and sizes of Super Tool saws available from stock.

6 **PLAIN AND SIDE MILLS** — Super Tool Company has a wide range of cutters designed for the "everyday" job as well as the "impossible" jobs. They are constructed of steel bodies with brazed Carbide cutting edges. These are the "work horses" of every metal cutting plant. They feature heat treated steel bodies and come in a variety of sizes and styles to fit any possible need or application.

7 **BI-AXIAL CUTTERS** — These cutters have accurate long-life Carbide cutting teeth for slotting steel. By its combination of angles, the Bi-Axial Cutter will wear on the periphery of the tool rather than on the sides, resulting in longer life and retension of original size

These tools are available for immediate delivery in a full range of sizes and designs.

Super
TOOL COMPANY
Division of Van Norman Ind., Inc.

SUPER TOOL COMPANY

21650 HOOVER ROAD • DETROIT 13, MICHIGAN

Whatever you make . . . there's a

WALDES TRUARC® RETAINING RING

designed to improve your product . . . lower assembly costs

function		for axial assembly					for taking up end-play					
							axial assembly				radial assembly	
nomenclature		basic		heavy duty	inverted		bowed		beveled		bowed e-ring	prong-lock®
series no.		5000 N5000	5100	5160	5008	5108	N5001	5101	5002 N5002	5102	5131	5139
application		Internal for Housings, Bores	External for Shafts	External for Shafts	Internal for Housings, Bores	External for Shafts	Internal for Housings, Bores	External for Shafts	Internal for Housings, Bores	External for Shafts	External for Shafts	External for Shafts
size range	in.	.250 – 10.0	.125 – 10.0	.394 – 2.0	.750 – 4.0	.500 – 4.0	.250 – 1.500	.188 – 1.500	1.0 – 10.0	1.0 – 10.0	.110 – 1.375	.092 – .438
	mm.	6.4 – 254.0	3.2 – 254.0	10.0 – 50.8	19.0 – 101.6	12.7 – 101.6	6.4 – 38.1	4.8 – 38.1	25.4 – 254.0	25.4 – 254.0	2.8 – 34.9	•

function		for radial assembly				self-locking types					
nomenclature		crescent®	e-ring	interlocking	reinforced e-ring	circular self-locking			grip-ring	triangular self-locking	triangular nut
series no.		5103	5133	5107	5144	5115	5105	5005	5555	5305	5300
application		External for Shafts	External for Shafts	External for Shafts	External for Shafts	External for Shafts	External for Shafts	Internal for Housings, Bores	External for Shafts	External for Shafts	With Threaded Screw
size range	in.	.125 – 2.0	.040 – 1.375	.469 – 3.375	.094 – .562	.094 – 1.0	.094 – 1.0	.312 – 2.0	.079 – .750	.062 – .438	•
	mm.	3.2 – 50.8	1.0 – 34.9	11.9 – 85.7	2.4 – 14.3	•	•	•	2.0 – 19.0	•	•

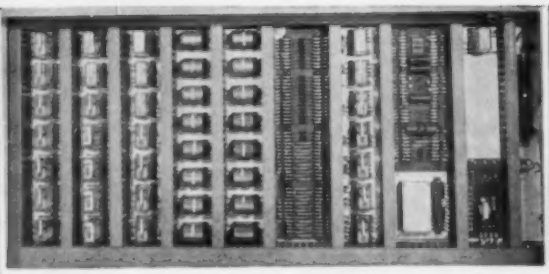
Truarc retaining rings are precision-engineered fasteners which simplify design, speed production and reduce material, machining and assembly costs. They may be used to retain components on shafts and in bores and housings .040" to 10" dia. – and rings as large as 40" dia. have been developed for special applications! Truarc rings are installed in easy-to-cut grooves and self-locking types are available which do not require any preparatory machining. Altogether, there are 50 functionally different types . . . some with as many as 98 sizes . . . in 6 metals and 13 finishes.

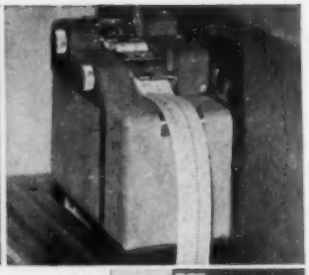
More than a fastener! Truarc rings function as mechanical components by replacing machined shoulders, set collars, rivets, threaded fasteners and other bulkier and more expensive fastening devices. They eliminate drilling, tapping, threading and other costly machining operations. Speed of assembly and disassembly further reduces manufacturing costs and simplifies field service.

Assembly tools for every requirement: Truarc offers you the most complete line of pliers, applicators, dispensers and portable magazine-fed tools for high-speed ring installation . . . even fully mechanized and automated equipment for mass-production assembly operations.

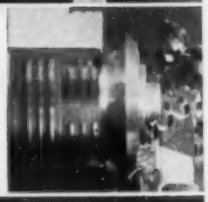
Engineering Service: We'll be happy to help you solve *your* fastening problems. Send us your blueprints or contact your local Truarc representative or distributor. They're listed in the Classified Telephone Directory under "Retaining Rings" or "Rings, Retaining."

WALDES KOHINOOR, INC.
47-16 Austel Place • Long Island City 1, N. Y.





The Tape-r-guide Lathe*



Numerical Control with Simplicity through Incremental Tool Travel

As you have heard, there is the wonderful new world of numerical control: the world of

- profitable small-lot production
- reduced finished parts inventories
- minimum tooling requirements
- maximum machine utilization
- fast setup
- quick job-to-job change-over
- unerring mechanical control.

Now, add its capability for accurate part-to-part duplication, and you can begin to judge the depth of its influence.

If you're shopping numerical control lathes . . .

then it is to your advantage to know that you can gain all these benefits in a numerical control lathe that has a low initial cost, easy year-after-year maintenance, simplicity of operation (and understanding), and gentle consideration of your valuable plant floor space. All this is yours in the new Barber-Colman Tape-r-guide. Why? Because of this thing called *incremental tool travel.*

Incremental tool travel is a Barber-Colman innovation in numerical control . . . a different approach to the tape-controlled lathe. To understand it, it's helpful first to consider the fundamentals of lathe operation.

A lathe does its work by holding a cutting tool against a rotating workpiece, feeding the tool in a longitudinal direction with respect to the axis of the workpiece, in a transverse direction, or in some combination of the two, to produce a desired contour. In a numerical control lathe, the operator has been largely replaced by nonhuman control. How, then, are these tool movements to be managed?

A choice of possible methods

Tool movement along a given axis could be controlled by establishing a sort of electrical yardstick along which a tool could travel, reading voltage levels along the way to determine its stopping point. This frequently used system would require a second, guiding yardstick with a critical voltage at the stopping point. When the voltage reading at the tool matches the predetermined voltage level at the stopping point, an electrical null would occur, telling the tool that it had reached the mark. Overshooting or undershooting could be detected by the variation from the null, and corrections made accordingly.

Such a system might require transducers to convert tool travel into corresponding electrical voltage which could supply feedback reading for making the comparison. Tool

The Barber-Colman system selects precise travel movements
thereby eliminating feedback reading equipment

(*Continued from previous page*)

travel would have to be programed from a "zero point," the beginning of the electrical yardstick, or the lathe would not be oriented with the workpiece. This in turn would produce the need for a computer to make the tremendous multitude of calculations: every excursion of the tool would require a programing from the zero point for every distance traveled.

Tool positioning accuracy in such a system could be fantastically high, if the electronic components are properly tuned, because of the error-correcting function. Positioning to ten-thousandths of an inch might be feasible, although this is not to say that the finished work would be accurate to such a fine degree, as the lathe itself may not be sufficiently responsive, or sufficiently rigid, to carry out the precise control signals to the required extent. The question is, then, is all this equipment, and this high degree of precision, really necessary in an *engine* lathe?

The better way

Barber-Colman engineers didn't think so, and they set out to develop a numerical control engine lathe that would be as simple as possible, would have a minimum amount of auxiliary equipment, and would still do all the work that an engine lathe is expected to do within the usual engine lathe tolerances. They started out, not taking an existing lathe and adding a control, but working out a system whereby the control would be built right into the machine, commencing with the controls that actually produce tool travel in lathes.

Working with these controls, they devised a method whereby *given increments of travel* could be produced in direct response to taped signals. They built a reliable system of clutches and differentials which makes possible the picking off of a variety of increments, increments that can be used singly or in combinations to cover any given distance with mechanical precision, arriving at any point within an accuracy of .001".

Their system involved no feedback reading, simply direct tool movement in response to the taped program. The movement of the tool is as direct and positive as the movement of one carriage space that results from one tap on a typewriter space bar. And it turned out to be a highly flexible system, also. By programing different increments of travel simultaneously on both the longitudinal and transverse axes, 700 different tapers can be cut, tapers that are smooth and step-free. It is also practical to program simple radii, chamfers and similar forms. Operations of this sort can be precalculated, then dropped in as appropriate in the form of subroutines.

Such a timesaving procedure is possible only in a system which is not tied to a fixed zero point. Systems which do have such a zero point must substitute a computer for a set of subroutines, since every point on a form (such as a radius) must be related to the zero point.

So, the new Tape-r-guide lathe emerges as a simple, closely integrated, computerless machine, having no separate consoles, no involved electronics. It has no need for memory circuits, since any memory function that is required can be coded right on the tape . . . the least expensive place to put it!

It is a machine that gives you *only what you really need* to capture the wonderful benefits of numerical control. For this reason, it is offered at a price that can put it in every progressive job shop.

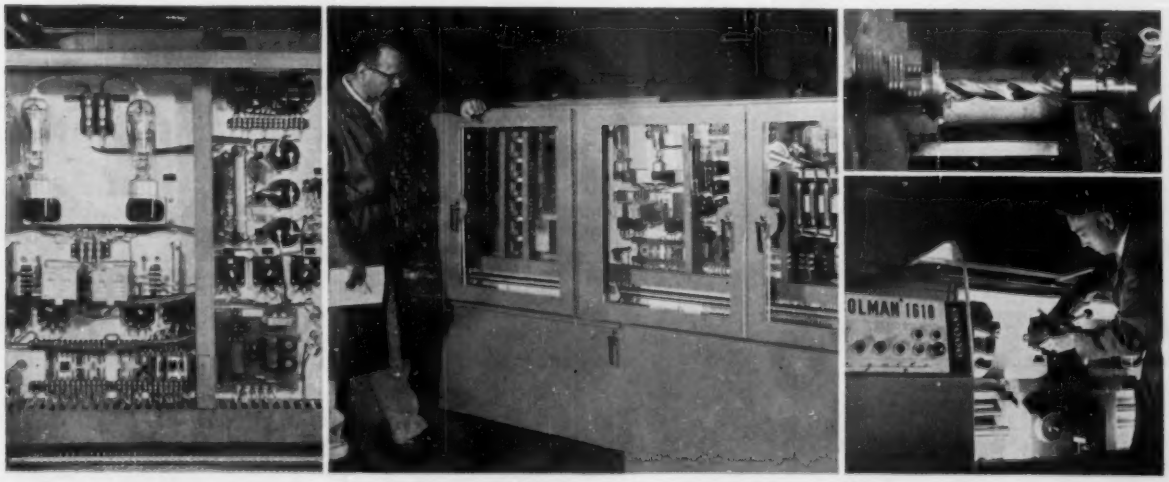
Why not talk Tape-r-guide with your Barber-Colman representative —today?

*No computer needed.

Barber-Colman Company

BARBER COLMAN

1012 Loomis Street, Rockford, Ill.



A "live" demonstration from Brown & Sharpe . . .

"You can see instantly with Brown & Sharpe

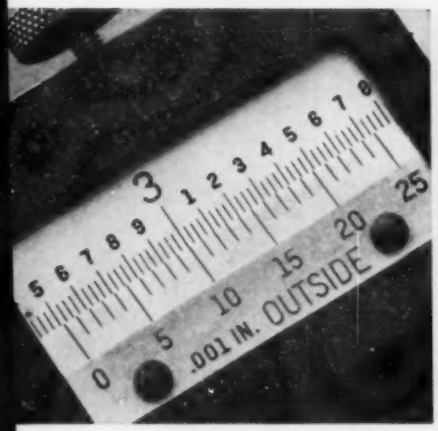
. . . Mr. Norman E. Ashley, General Foreman, Precision Tool

"'**Easy on the eyes'** is the first big impression you get from a Brown & Sharpe vernier tool. See the black window frame on this B&S Super Vernier Caliper? It centers your eyes on the vernier scale — sets off your reading, loud and clear. What a difference this makes, yet it's just one of several features that make B&S verniers easier to read accurately.

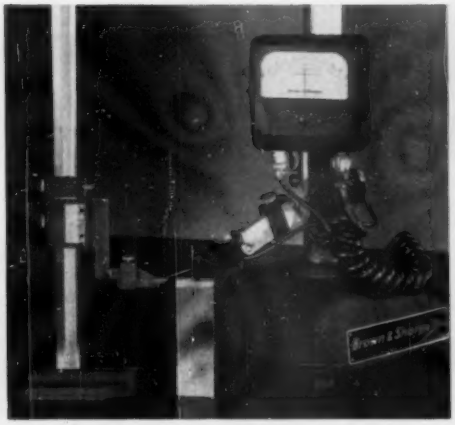
Use Reader Service Card, CIRCLE 44

why accuracy comes easier precision vernier tools"

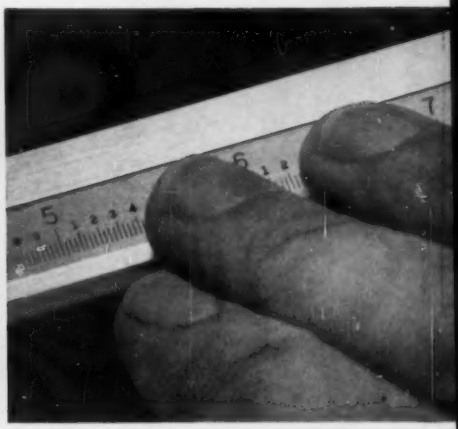
and Gage Groups, Brown & Sharpe, Industrial Products Division



"There's no doubt which line to read, when you work with these widespread graduations. The scale is twice the length of old-type vernier scales — twice as easy to see. Graduations and figures are jet black, machine cut deep into a satin chrome finish that eliminates glare and confusion.

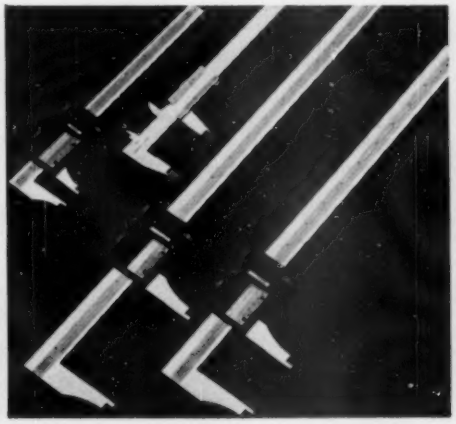


"Your reading is more accurate, too. Brown & Sharpe exceeds Federal Specification GGG-C-111a for tolerances — holds flatness of beams and jaws to .000050". Parts are machined, and assembled precisely. Each tool carries the assembler's personal mark; an added guarantee the tool is right.

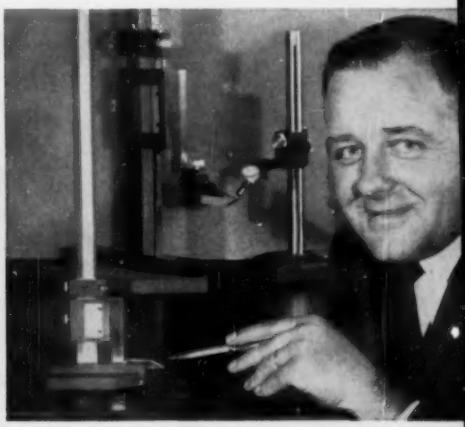


"And, your tool stays accurate longer. Careful hardening, stress relief and a satin chrome finish protect B&S verniers against wear, rust and corrosion. Deep cutting, on a recessed background, makes the graduations and numbers almost impossible to rub off. A real long-term investment!

"Joseph R. Brown, invented this tool, the first practical vernier caliper, back in 1851. We've been adding refinements to it ever since. You can trace the accuracy and convenience of the Brown & Sharpe vernier calipers you buy today — right back through this 110 years of experience.



"Standard sizes of B&S vernier calipers are 6", 12", 24", 36" and 48". We've made specials up to 16 feet in length. They're graduated front and back so you read inside measurements from one side, outside measurements from the other side, directly in .001", with no danger of reading the wrong scale.



"Brown & Sharpe vernier height gages have similar advantages for lasting accuracy and easy, direct reading. You also get an offset arm and slotted base that permit zero reading, plus a 2-way marker for measurement under or over. Call your local industrial distributor for details and prices."

Brown & Sharpe Mfg. Co., Industrial Products Division, Providence 7, R. I.

Brown & Sharpe PRECISION CENTER

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10 WAYS TO GRIND AT LOWER COST...

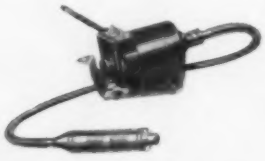
tool post grinders

Precision built for secondary grinding operations on lathes, millers, planers, shapers, grinders, boring mills to save handling, moving, set-up and down-time. Easily adapt to bench use or special machines. Deliver accuracy to .0001", surface finishes to 6 micro-inches. Easy, simple mounting and use by regular machine operators. 9 models, 1/14 to 3 hp., swing 1/8" to 12" wheels. Priced from $93, FOB Racine.

DUMORE® PRECISION GRINDING TOOLS

hand grinders

Rugged, lightweight, powerful. Balanced, precision construction provides true spindle alignment and rigidity for longer wheel life, maximum service on fine die work or rough deburring. 7 models, 1/20 to 1/4 hp. Priced from $41.50, FOB Racine.

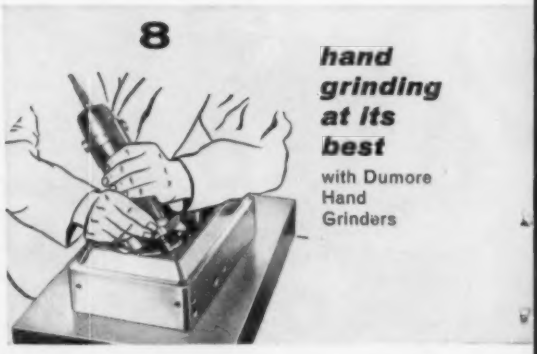


flex-shaft tools

Easy-to-handle, power-packed, versatile. Speed cutting, polishing, routing, grinding, deburring on all metals and plastics. 3 models, 1/15 to 1/4 hp. Priced from $74.50, FOB Racine.

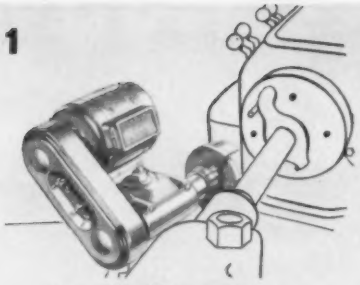
quills

Finest precision construction for use as interchangeable spindles on Dumore Tool Post Grinders...inexpensive heads in special set-ups...replacement spindles or high-speed attachments for standard machines. 5 types, 25 models. Priced from $107.50, FOB Racine.



YOUR DUMORE DISTRIBUTOR HAS COMPLETE STOCKS FOR FAST DELIVERY

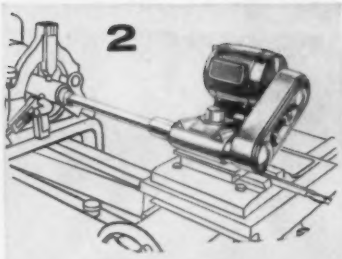
1



small diameter external grinding

precision to within .0001"

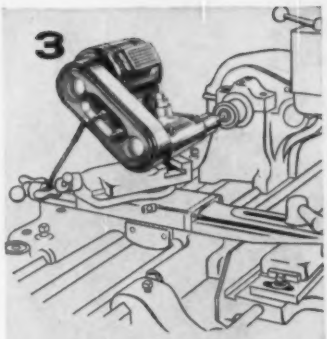
2



deep hole internal grinding

with Dumore internal grinding quills to depths up to 24"

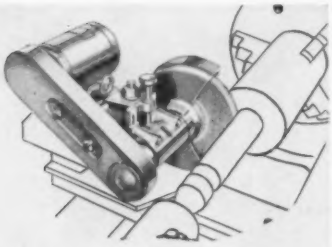
3



small hole internal grinding

down to 1/8" diameter with mounted wheels or burrs

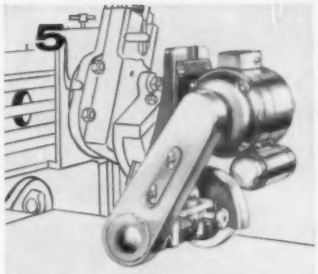
4



large diameter external grinding

ample power for rapid stock removal; maximum production on big jobs

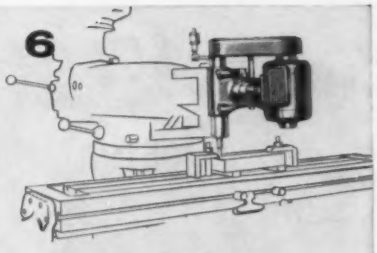
5



surface grinding

convert planers, shapers, millers to precision surface grinders

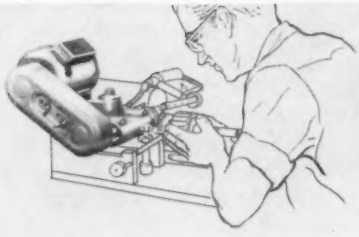
6



irregular shapes

grind any contour, shape or radii determined by table travel

7

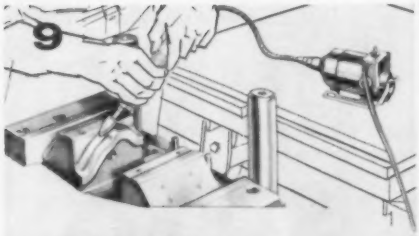


single purpose grinding

on the bench or in special set-ups

YOU CAN DO MORE WITH **DUMORE®** PORTABLE PRECISION METALWORKING TOOLS

9



lightweight working convenience

Dumore Flex-Shaft Tools

10

precision spindles wherever needed

Dumore Precision Quills

THE DUMORE COMPANY

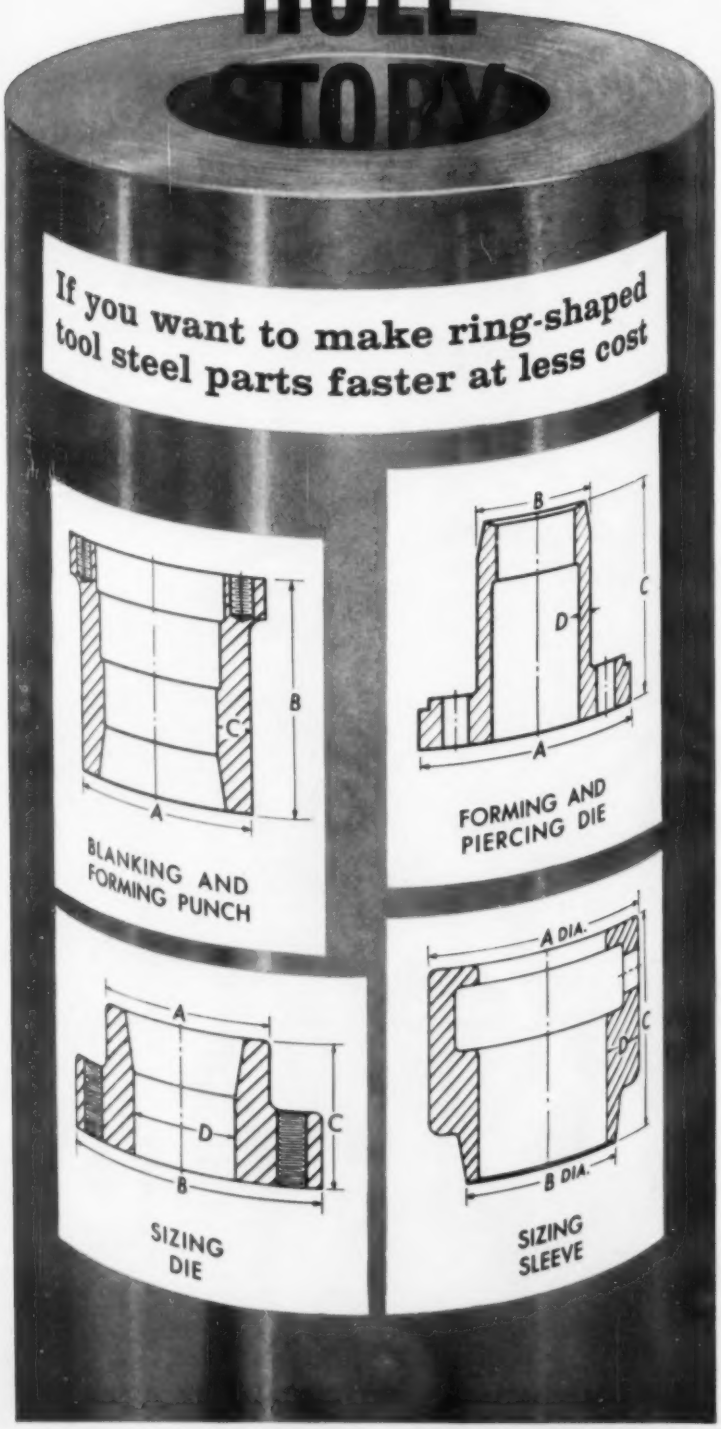
1310 Seventeenth Street,
Racine, Wisconsin

HI-SPEED DRILL UNITS • DRILL-N-TAP UNITS
DRILL UNITS • DRILL HEADS • MICRO-DRILLS
DRILL GRINDERS • TOOL POST GRINDERS
HAND GRINDERS • FLEX-SHAFT TOOLS
QUILLS AND ACCESSORIES • VERSA-MIL

When you have a need for erector-type components for special machines... machining heads, feed tables, machine beds... contact our subsidiary Master Manufacturing Company, Hutchinson, Kansas.

...SEE HIM FOR A DEMONSTRATION...OR WRITE FOR BULLETIN G-60-C

GET THE HOLE STORY



You don't have to bore a hole through bar stock to make hollow parts. Just buy Graph-Mo® Hollow Bar and start with finish boring. The hole's already there.

But the hole is only part of the story. Graph-Mo has free graphite in its structure so it machines 30% faster than ordinary tool steels. Graph-Mo also has diamond-hard carbides in its structure, so it outlasts ordinary tool steels three to one by actual user reports.

Stability? Try this. A master plug gage made of Graph-Mo showed less than ten millionths of an inch dimensional change after twelve years of use.

There is only one Graph-Mo and it's made by the Timken Company. Buy Graph-Mo in the hollow bar form to cut the cost and improve the quality of your ring-shaped tool steel parts. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Also makers of Tapered Roller Bearings and Removable Rock Bits.

TIMKEN®
FINE ALLOY
STEEL

TIMKEN GRAPHITIC STEELS ARE AVAILABLE FROM STEEL SERVICE CENTERS IN MORE THAN 40 CITIES IN THE UNITED STATES AND CANADA

Call on us at the National Metal Exposition, Cobo Hall, Detroit, October 23-27, Booth 739

Use Reader Service Card, CIRCLE 48

1. Efficient. An important addition to Simonds line of quality cutting tools, Simonds new Hole Saws saw holes cleanly and efficiently in machinable materials up to 1⅛" thick. Ideal for portable tools, drill presses, lathes, boring mills, and milling machines . . . Simonds floating pin-drive arbor assures positive non-slip cutting.

2. Shatterproof. Made with a special wear-resistant high speed steel cutting edge, these saws *stay sharp* for exceptionally long periods. Rugged. Tough. Simonds cutting edge is permanently bonded to a tough alloy steel body for maximum strength and resiliency . . . makes these the sturdiest hole saws you can buy.

3. Easy-Out. Simonds knock-out slots allow easy removal of cores. "Follow through" design of cap permits sawing deep holes in stacked or layers of material where cores can be removed. Now available from your nearby Simonds Distributor for hole sizes from 9/16" to 6" diameter. 6 mandrel sizes offered for light to heavy cutting. Call and try some today. Discover how "Simonds means savings whatever you cut."

SIMONDS
SAW AND STEEL CO.
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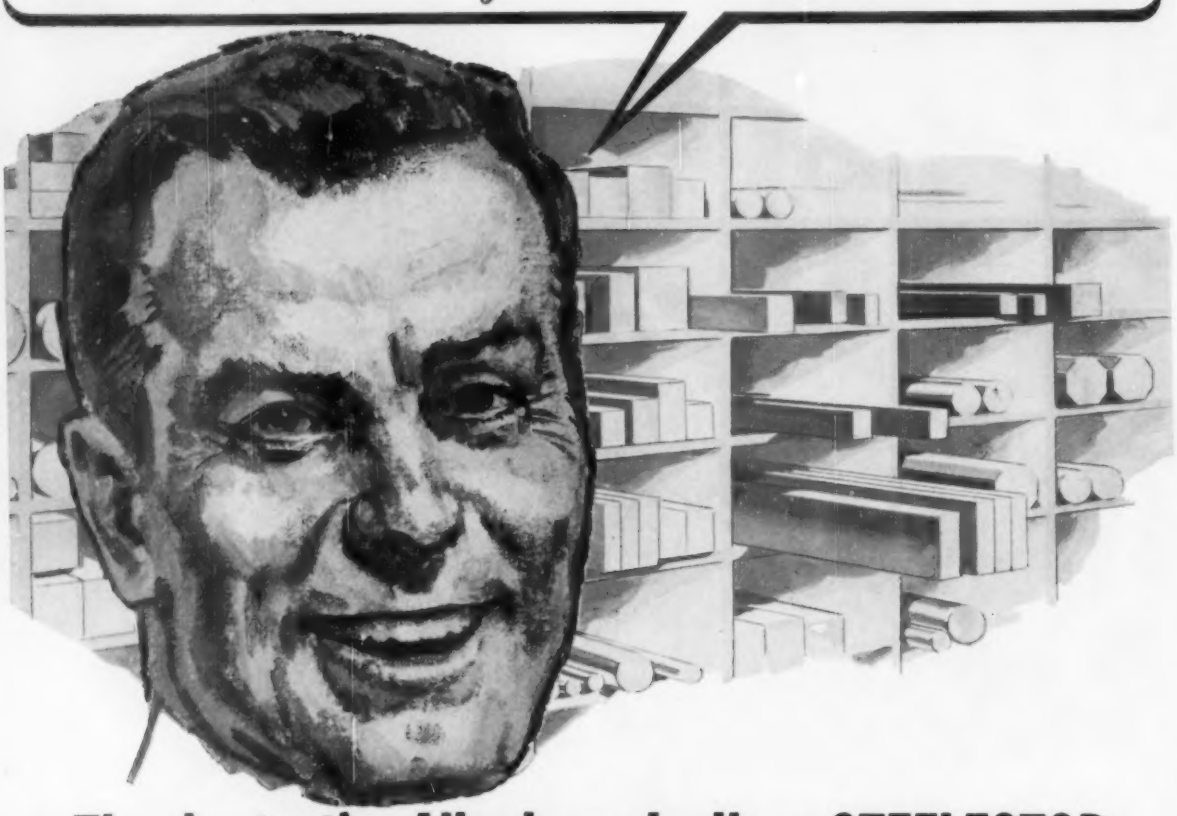


Thanks to the Allegheny Ludlum STEELECTOR

"We simplified tool steel selection immensely when we started using the A-L STEELECTOR System. It slashed our selection time to seconds. And our local warehouse always has the grade and size we need in stock—ready for immediate delivery.

"Here's how we use the STEELECTOR System: We check bar graphs of the STEELECTOR Card for the job at hand (there are cards for hot work, high speed, and tool room grades) to compare the abrasion resistance, toughness, size stability, machinability, and red hardness of the STEELECTOR grades. In seconds we can pick the best combination of properties.

"We confirm our selection with the STEELECTOR Data Stock List. (There is a List for each STEELECTOR grade.) The Data Stock List itemizes every size and shape in stock. It tells us before we order that the particular grade and size we need is ready for immediate delivery. The STEELECTOR System and quick warehouse delivery have enabled us to reduce our own inventory.

"The Data Stock Lists also tell us proper hardening, tempering, and annealing temperatures. The steel analysis and AISI number are listed along with a description of the steel's properties. And a list of suggested working hardnesses for typical applications serves as a check on our use of the grade."

The STEELECTOR System is remarkably easy to use. If you haven't investigated it yet, ask your A-L representative for your copy of the colorful, 10-page STEELECTOR Booklet, or write: ***Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania.*** Address Dept. TE-10-2.

STEELECTOR PROGRAM

ALLEGHENY LUDLUM

Tool Steel warehouse stocks throughout the country

BATH Tap'n Gage TIMES

A series of technical discussions that will be helpful in getting better results from tapping and gaging operations

Vol. 1 No. 21

Subject: Resharpening Tap Chamfers:

As with all cutting tools, taps perform best when sharp. Dull taps cut rough and sometimes oversize threads; require more power and higher tapping torque which may effect tapping speeds. Teeth of dull taps chip, load and break, resulting in high tapping costs and excessive product spoilage.

Taps that have lost their keen cutting edge through constant use can generally be reconditioned by regrinding the chamfer provided the teeth are not badly chipped or are not heavily loaded with the material in which the taps were used.

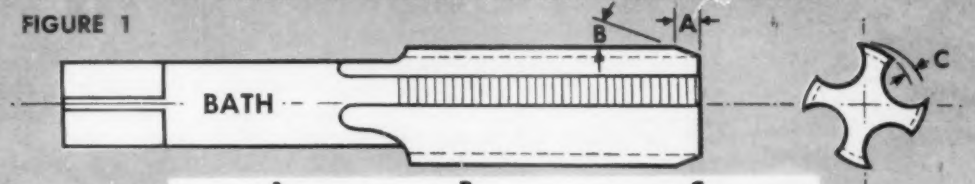
At best, resharpening tap chamfers properly by hand is a difficult if not impossible task and we do not recommend such a practice. (See Fig. 2). However, there are several machines and attachments on the market suited to this type of work and one of these should be used.

Care should be taken to grind the correct chamfer angle and chamfer relief when resharpening dull taps. This may be done by reproducing a new tap as closely as possible or by following the specifications in Fig. 1.

It is also important to retain the point diameter of the chamfer to approximately the same size as the root diameter of the tap (See Fig. 3). To accomplish this, it may be necessary to grind back the front end of the tap before regrinding the chamfer.

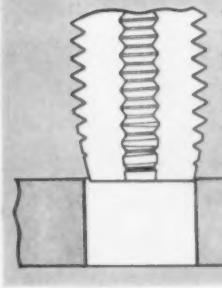
CHAMFER ANGLE AND CHAMFER RELIEF SPECIFICATIONS
for UNIFIED and AMERICAN NATIONAL FORM OF THREAD

FIGURE 1



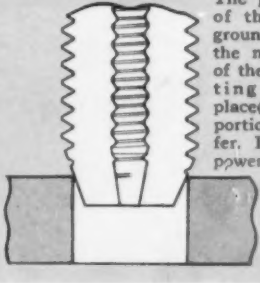
A Length of Chamfer	B Angle of Chamfer	C Relief per 1/16" of Land Width
Plug, 3 to 4 Threads	10° to 13°	.002" to .004"
2 to 2½ Threads	15° to 19°	.003" to .005"
1½ Threads	25°	.003" to .005"

FIGURE 2



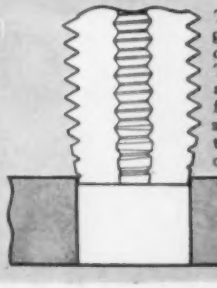
Uneven grinding is often the result of resharpening the chamfer by hand. This forces the cutting load on fewer lands and as a consequence, oversize holes and lower production per tap is the outcome.

FIGURE 3



The point diameter of the chamfer is ground too far below the minor diameter of the tap. The cutting burden is placed on a small portion of the chamfer. Result: greater power consumption and short tap life. End of tap should be ground back before resharpening.

FIGURE 4



The chamfer is ground evenly on all lands. The point diameter of chamfer is correct in size, allowing all threads of the chamfer to share the cutting burden.

When your taps are worn or chipped too badly for resharpening or if you are in need of new taps, call your Bath distributor or contact Worcester for carefully ground, high quality Bath taps, designed for precision tapping, long wear and low cost per threaded hole.

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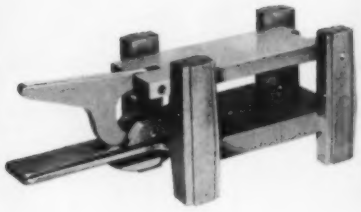

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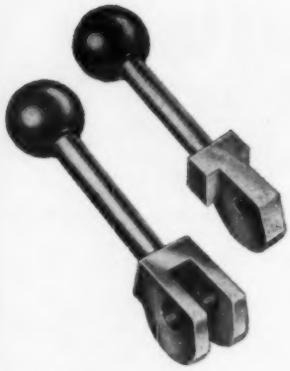

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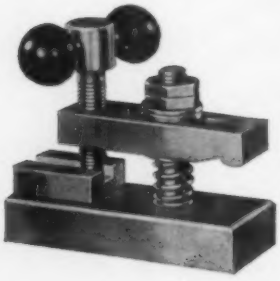

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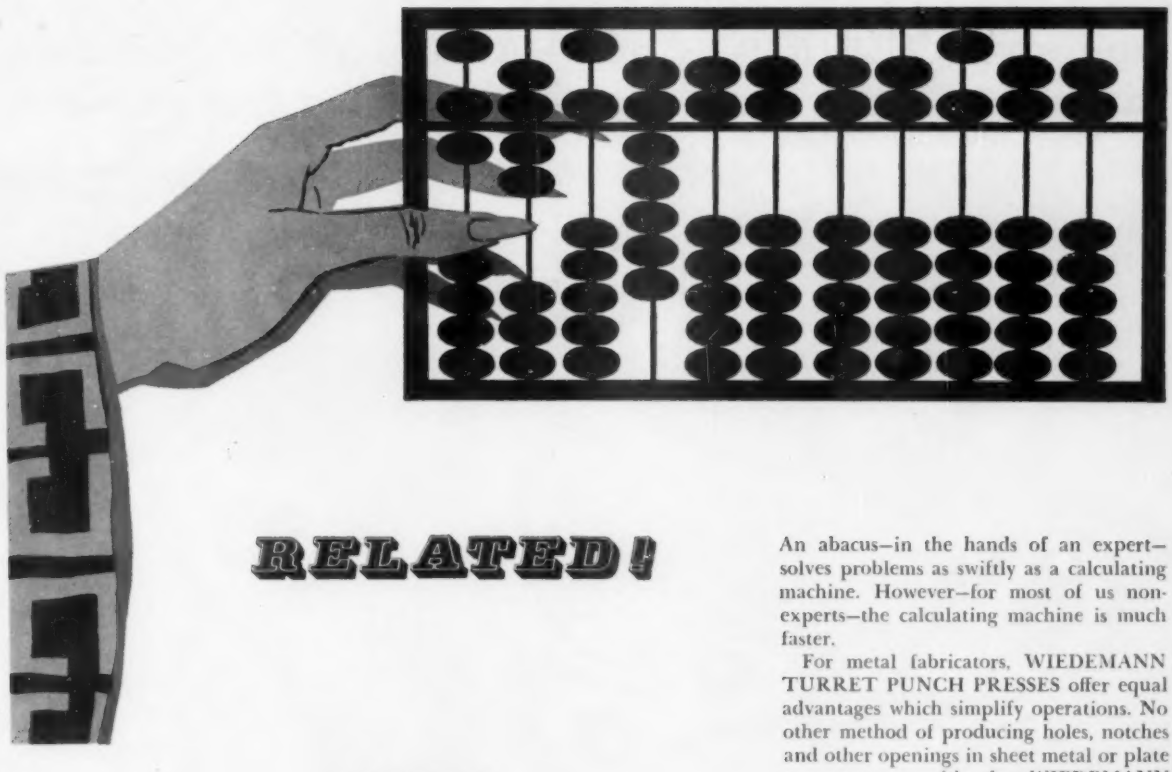

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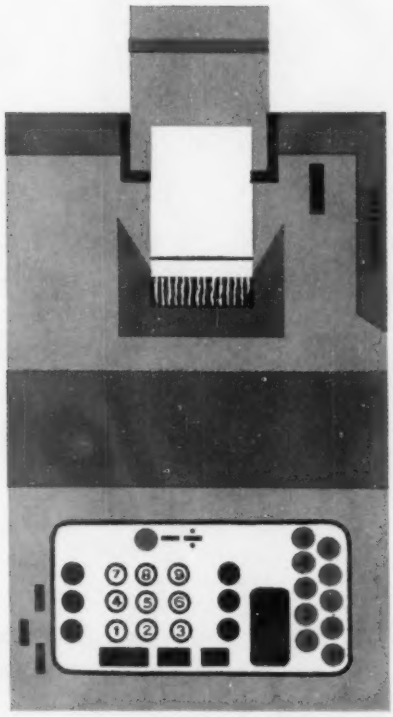

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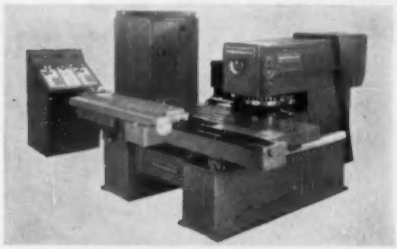

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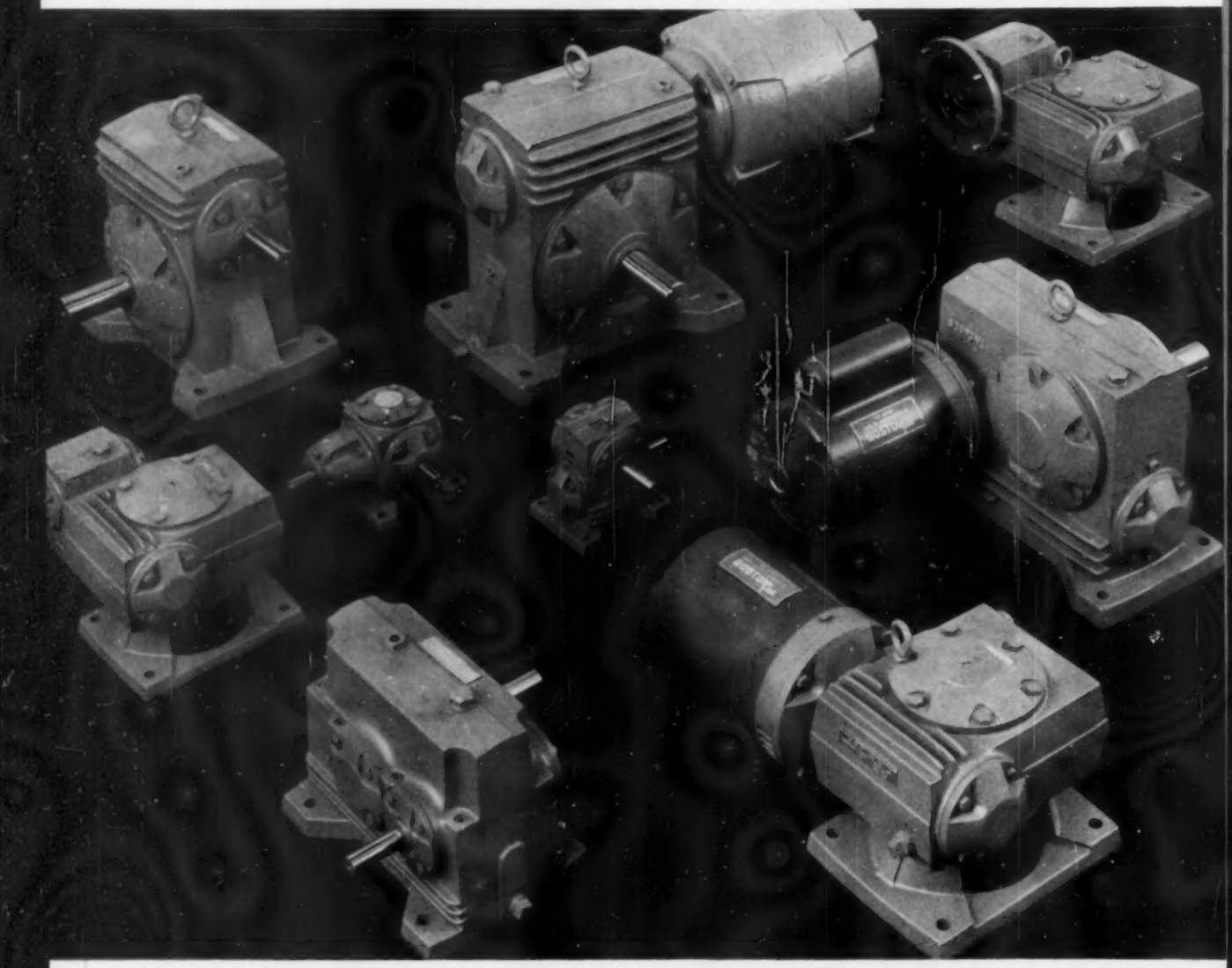

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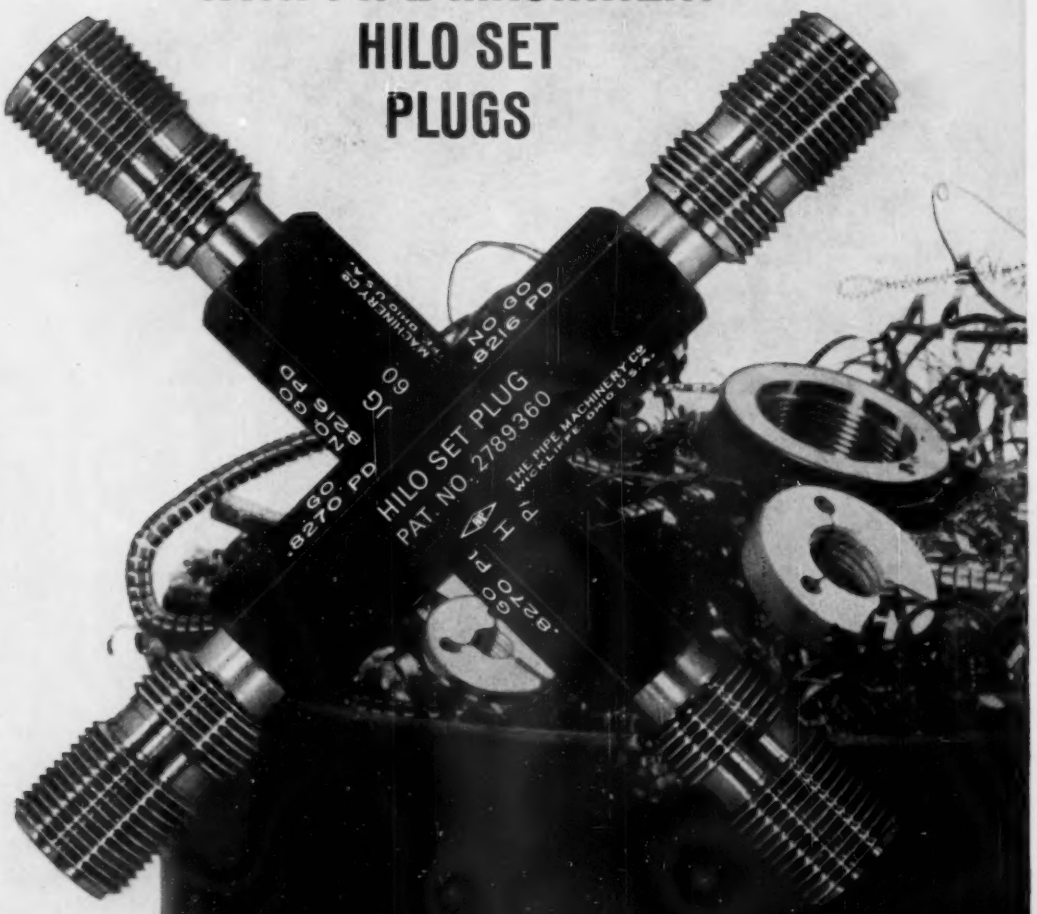

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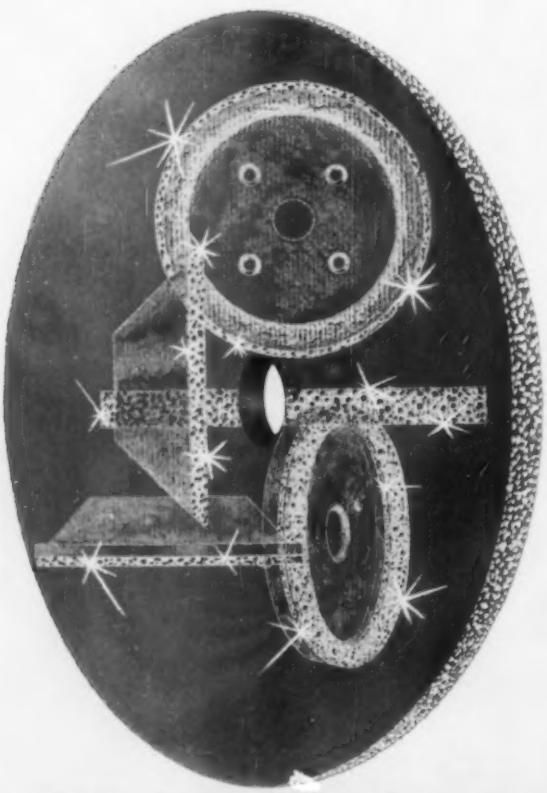

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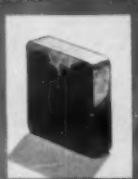

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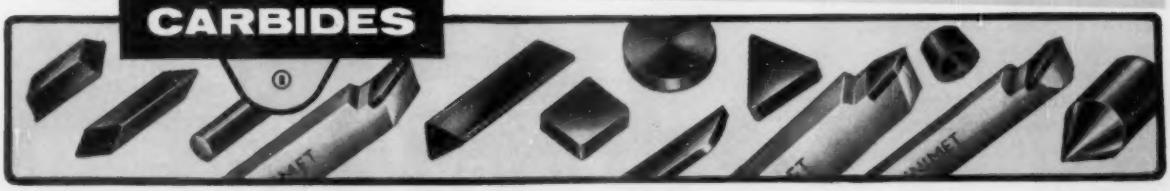

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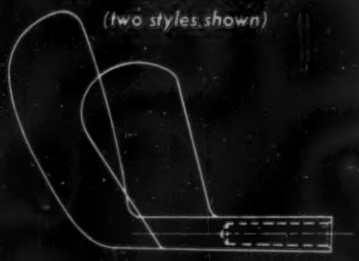

Vertical Unit with Milling Head
1—MILL OFF THE STEM END

Four Horizontal Units
2—DRILL HALF DEPTH
3—DRILL FULL DEPTH AND CHAMFER
4—ROUGH TAPER REAM
5—FINISH TAPER REAM

6—LOAD AND UNLOAD

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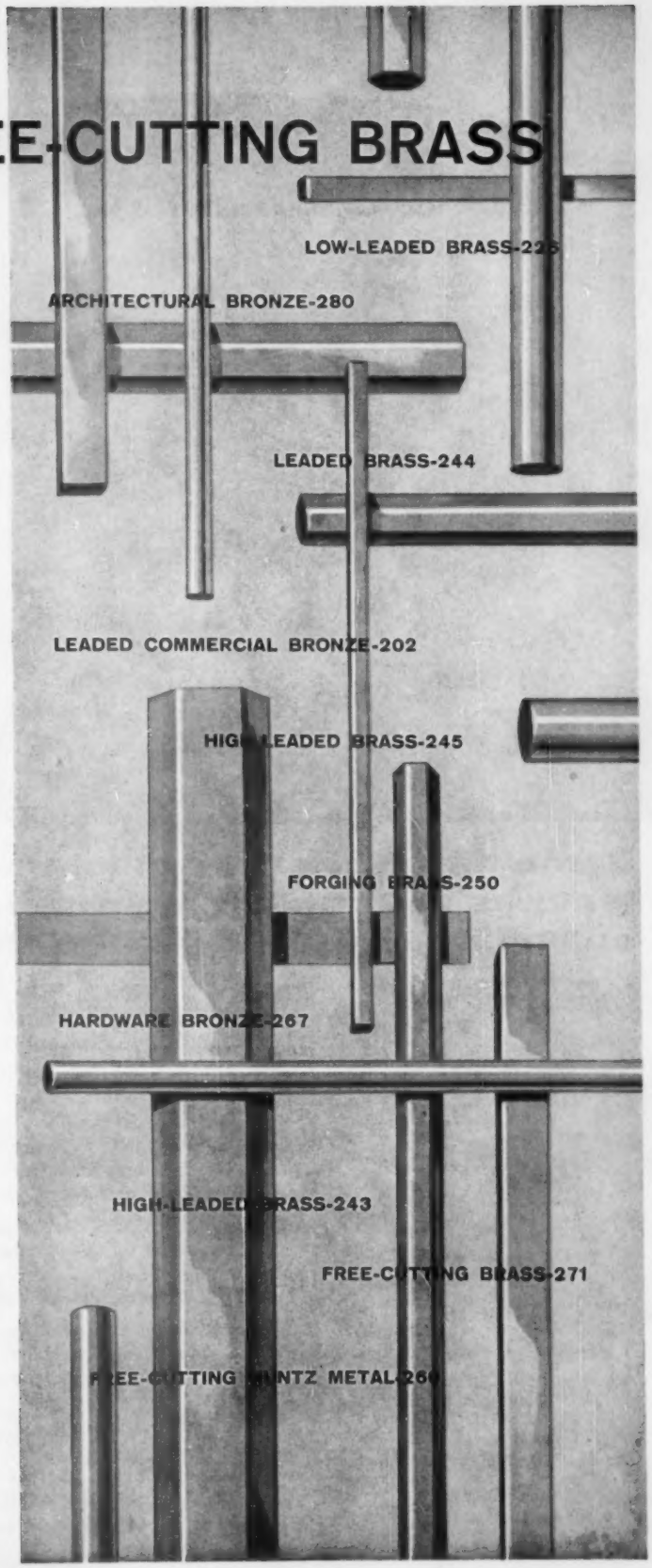

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Now you can buy a 26" DoALL machine with hydraulic table at a 50% saving in price over previously available models

Same throat capacity . . . same worktable features . . . coolant system . . . same cutting rates with Demon® HSS blades*

Model 1612-U
only $995.00
(Base Machine)

Another DoALL bargain

—a multipurpose Utility machine with built-in DoALL quality and performance. Has 16" throat and 12" thickness capacity.

Uses new Dart® blades that outcut and outlast any other carbon steel blades—or your money back!

Ask for demonstration.

Everything about this new DoALL model 2612-2H band machine is almost identical to DoALL's famous 26" Contour-matic® machine. Principal differences are in table size and elimination of certain hydraulic controls—*but the price is 50% lower!*

You get the hydraulically powered, infinitely variable feed table that tremendously multiplies your operator's productivity, lets him turn out more work with less effort, whether it's a one-of-a-kind job or production run.

You get the full 26" throat capacity, the built-in coolant system, and all of the standard equipment, including one Demon high-speed-steel saw band that will deliver cutting rates up to 12 square inches per minute in mild steel.

Here is a tremendous buy never before available in a genuine DoALL power feed machine of this size and capacity—and it has DoALL quality and performance through and through.

Get all the facts before you buy any vertical contour sawing machine—call DoALL today.

THE DoALL COMPANY, Des Plaines, Illinois
Serving you locally through your DoALL Sales-Service Store

* U.S. PAT. NO. 2,786,788

B-67

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Price $10,336 — Model 2613-3 — Rent $86.21 per week
Contour-matic
23 models available
BAND MACHINES

Price $1475 — Model DH-612 6" x 12" — Rent $9.46 per week
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Price $2761 — Model C-12 — Rent $17.70* per week
6 models available
POWER SAWS

CUTTING TOOLS

18 types
All sizes

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Shop blocks $130

50 sets available

Price $80 — 18" x 24"

All sizes • grades

SHOP SUPPLIES

For Every Purpose

2,000 Sizes • grades

Find Your DoALL STORE In The "Yellow Pages"

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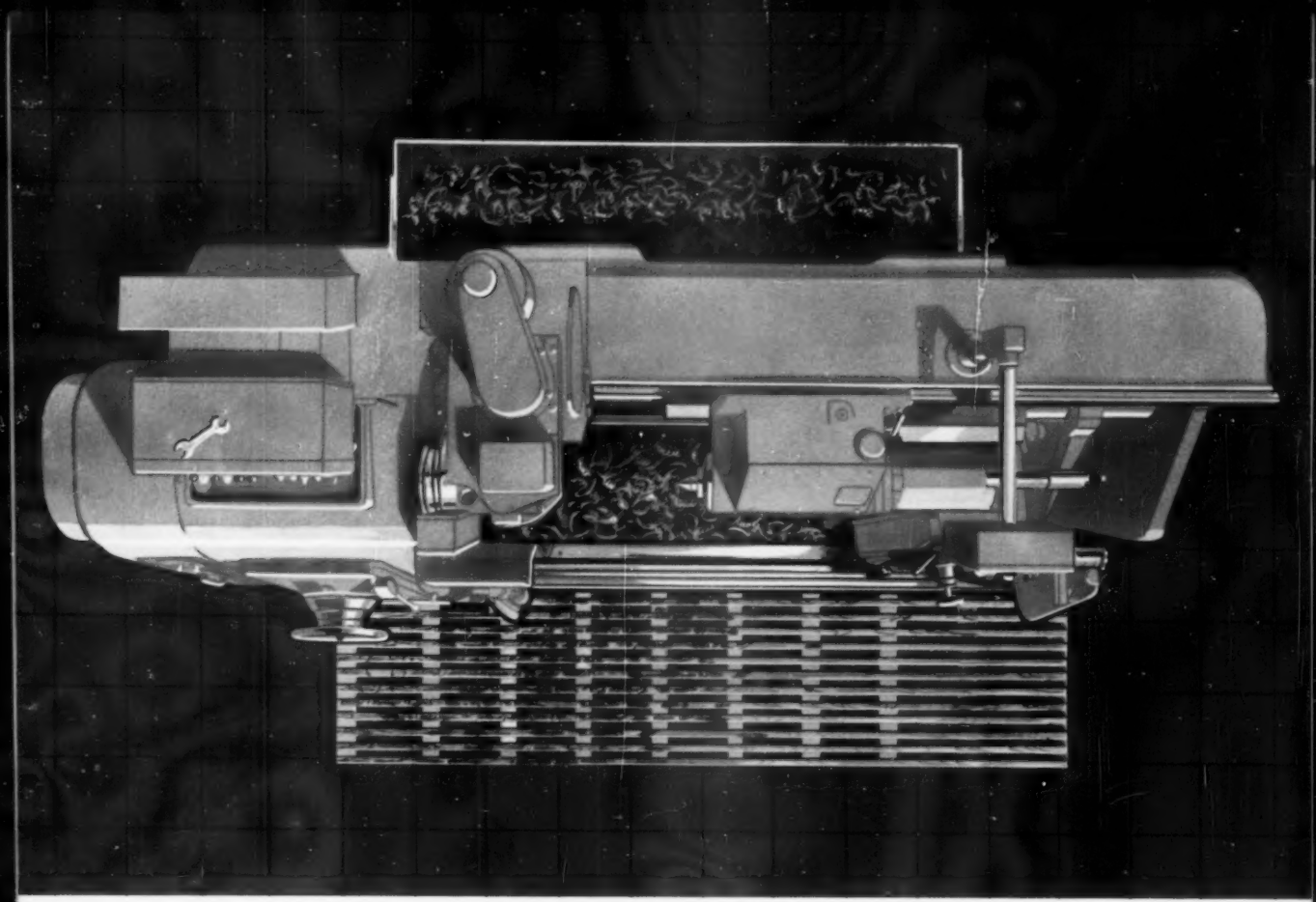


You can turn a profit on a New Britain +GF+ Copying Lathe

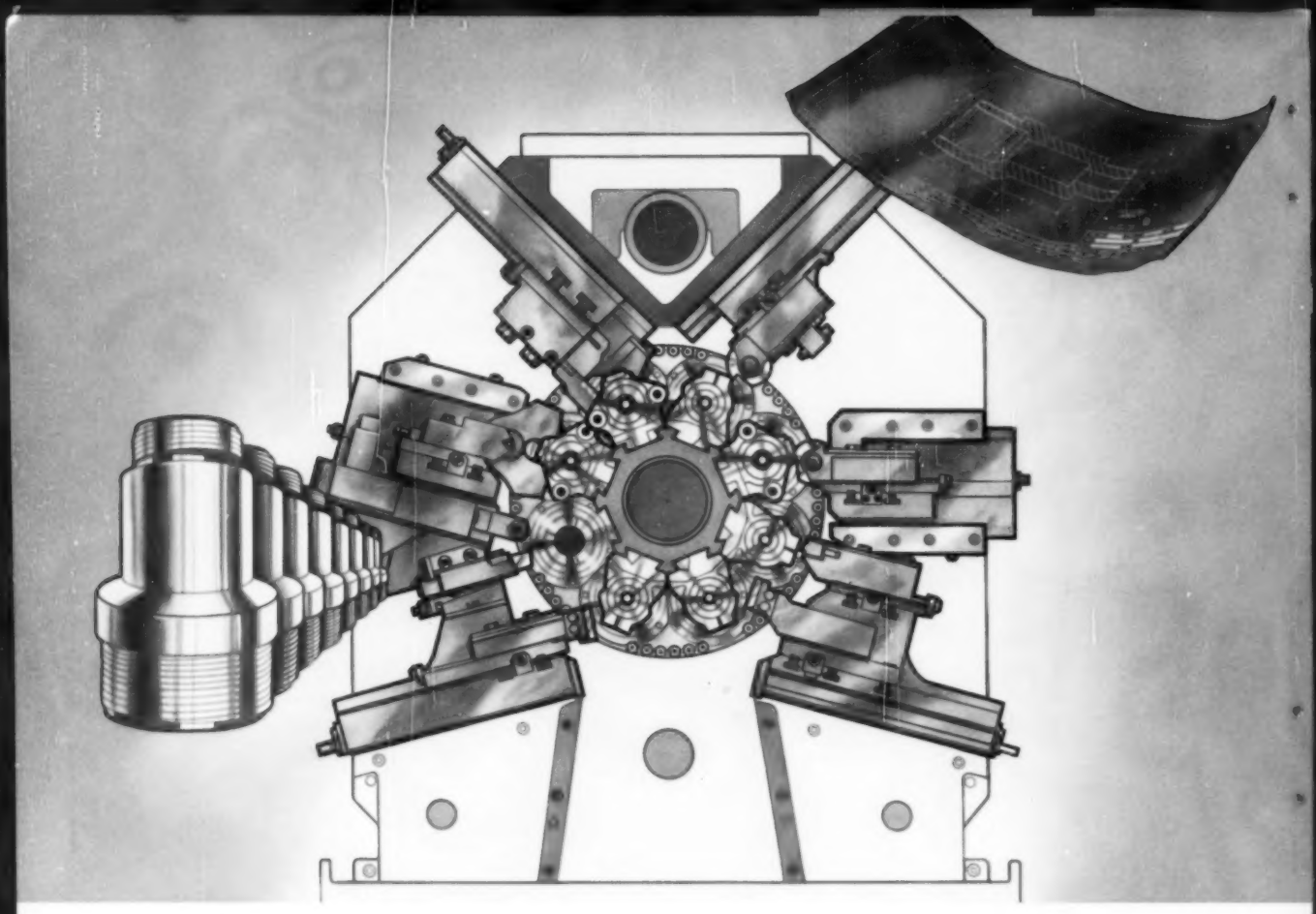
Here's a birdseye view of a New Britain **+GF+** Copying Lathe. It shows some important differences between this machine and conventional lathes with copying attachments. The point here is this—*the most effective use of the single-tool copy-turning principle can be made only with a machine designed from the ground up for this type of work.* The New Britain **+GF+** is just such a machine. Notice the chip pan. It's big (it has to be) and located for easy removal of chips from the back of the machine. The design of the work area allows for unobstructed free-fall of chips out of the way and into the pan.

The New Britain **+GF+** is massive and rugged, with plenty of power—up to 40 h.p., if you need it. It's simple to operate, quick to set up and change over. The single-point tool can be changed in one minute and it out-produces gang tooling setups in the bargain. Turning is controlled by either a template or a prototype. External and internal copying are accomplished in one set-up with special tooling.

The possibilities for short or long run chucked and between centers work on the **+GF+** are wide and varied. Because the work is produced with good surface finish and dimensional accuracy, grinding can be reduced and, in some instances, eliminated. Large diameters are broken down economically by successive parallel cuts, automatically if desired, with optional two-cut or multi-cut recycling.

You've got to see one of these machines in action to fully understand the kind and quantity of work they are capable of producing. Contact your New Britain Representative for demonstration arrangements or write The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division - New Britain, Connecticut



Unlimited tooling combinations with New Britain Bar Machines

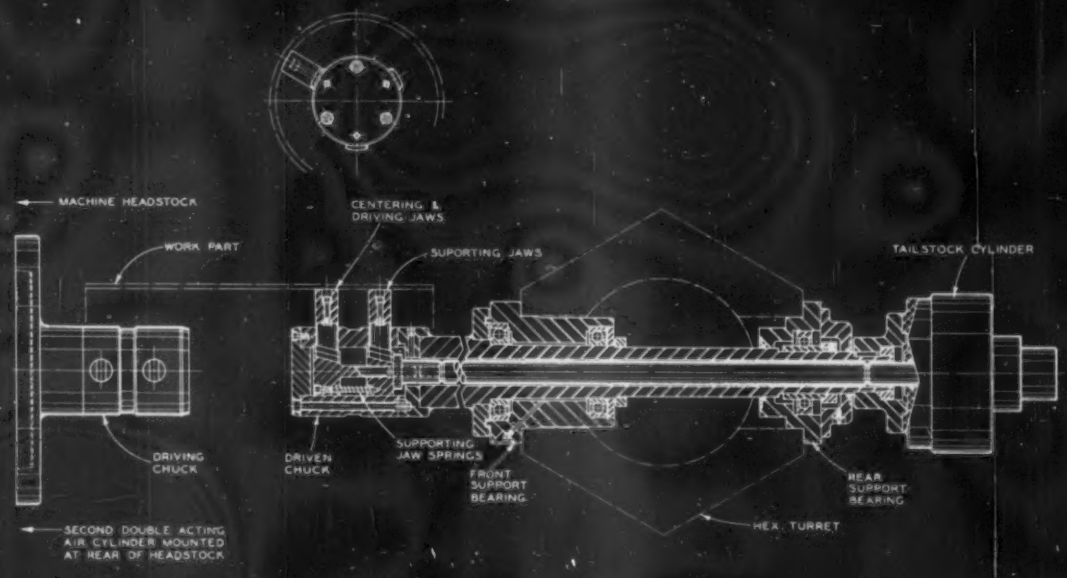
Nothing can out-date your operation quicker than better machines in the hands of a competitor. In the race to keep ahead on quality, price and delivery, nothing can put you out front faster than machines capable of consistently producing the highest quantity of finished pieces at the lowest possible cost. New Britain's new series of bar machines represents in every way the most advanced bar-turning units available. Each of the four-, six- and eight-spindle models has been redesigned, adding new features and improving older ones. Unlimited cross slide and end-working tool combinations, extremely fast operation (even on stainless) and a variety of models and features to choose from add up to some good reasons for incorporating New Britains into your replacement or production expansion plans.

The eight-spindle model is the largest, most modern eight-spindle bar machine available. It has a stock capacity of up to 2⅝″ and provides six independently-operated cross slides. As with all New Britain bar machines, the operations of the cross slides and end-working tool slide are disc-cam controlled for positive actuation, close tolerance machining and easy, rapid change-overs.

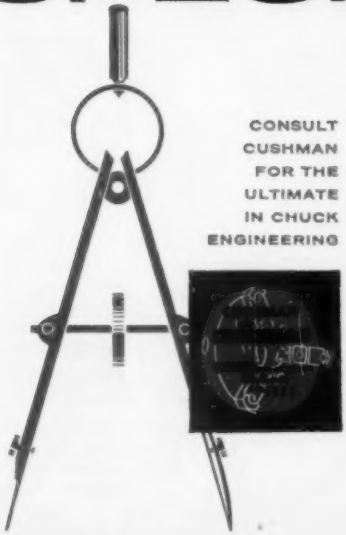
This is only a very small part of a story that is bound to interest you. The whole story and its significance in terms of your profits is available from your New Britain Representative. If you prefer, contact us directly at The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division - New Britain, Connecticut

SOLVE YOUR DIFFICULT WORKHOLDING PROBLEMS WITH



SPECIAL CHUCKS



CONSULT CUSHMAN FOR THE ULTIMATE IN CHUCK ENGINEERING

The assembly print reproduced above is but one of many examples of special chucks designed and engineered to meet unusual workholding and machining requirements. Cushman Special Chucks are being used in many diverse industries enabling manufacturers to meet realistic production quotas, maintain close tolerances and achieve lowest cost on both short or long runs.

If you have a workholding problem, consult Cushman. Your problem may have already been solved.

THE CUSHMAN CHUCK COMPANY · HARTFORD 2, CONNECTICUT

Manufacturers of Air and Manually Operated Chucks, Power Wrenches, and Face Plate Jaws.

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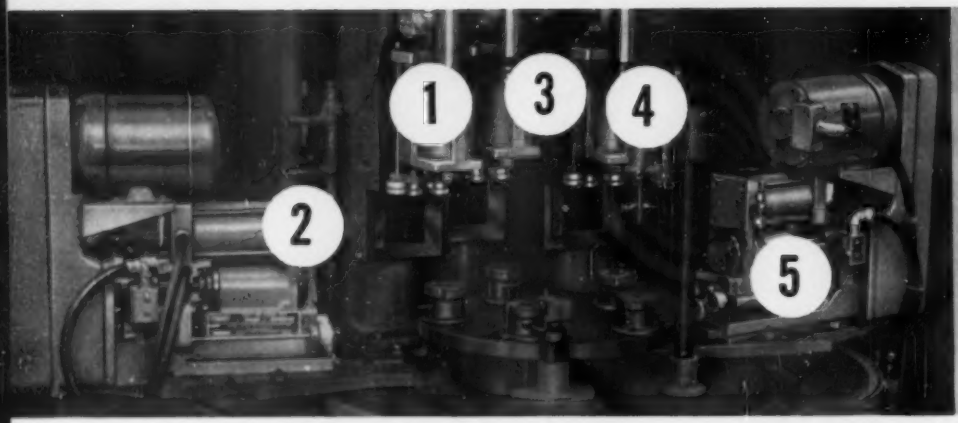
The Answer To Important Cost Reductions In 2nd Operation Machining

5 SIMULTANEOUS OPERATIONS



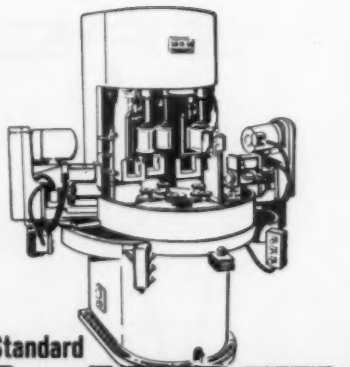
OPERATIONS PERFORMED: 1. Combination drill and counter sink, face to length and chamfer. 2. Cross drill through. 3. Vertical plunge, straddle mill. 4. Tap. 5. Cross mill two slots.

One Representative Example From Our Comprehensive File of Case Histories.

IF YOU HAVE operations such as those shown above (or countersinking, centering, eccentric turning, milling, deburring, threading, hollow milling), they can be performed simultaneously on Standard MSO — with extreme accuracy and at high speed.

Standard MSO eliminates Hand Screw Machines, Drill Presses, Light Milling Machines, Tapping and Threading Machines, Single Purpose Machines.

These are important savings — To consider possible applications in your situation — send for our new folder #61 giving details of components and complete specifications of MSO — also, our illustrated book of case histories which contains detailed, mechanical drawings. We shall be glad to send these without charge.



Standard MSO

MULTIPLE SECONDARY OPERATIONS

A high speed, versatile machine which performs many multiple, second operations — simultaneously — with great accuracy. Complete details regarding mechanical features and specifications contained in a new booklet available on request. Ask for Booklet, No. 61.

MACHINERY DIVISION

Standard Tool & Manufacturing Co.

715 SCHUYLER AVENUE • LYNDHURST, NEW JERSEY

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HEADQUARTERS

for quality gun drilling tools!

THE Star GUN DRILL

THE Starbore MULTIPLE FLUTE REAMER U.S. PAT. NO. RE24769

THE Starbore DRILL U.S. PAT. NO. 2898786

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Star offers a complete line of precision gun drilling tools. There is a size and type specially engineered for every production, material or finish requirement. Every tool in the line is precision built of the best possible materials.

Every tool has been thoroughly tested for efficiency and service life, both in our own research and development laboratories and in metal-working plants throughout the country.

When you buy Star Gun Drilling Tools you buy proven quality and efficiency.

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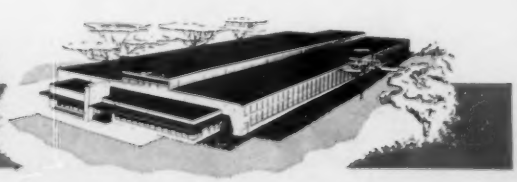
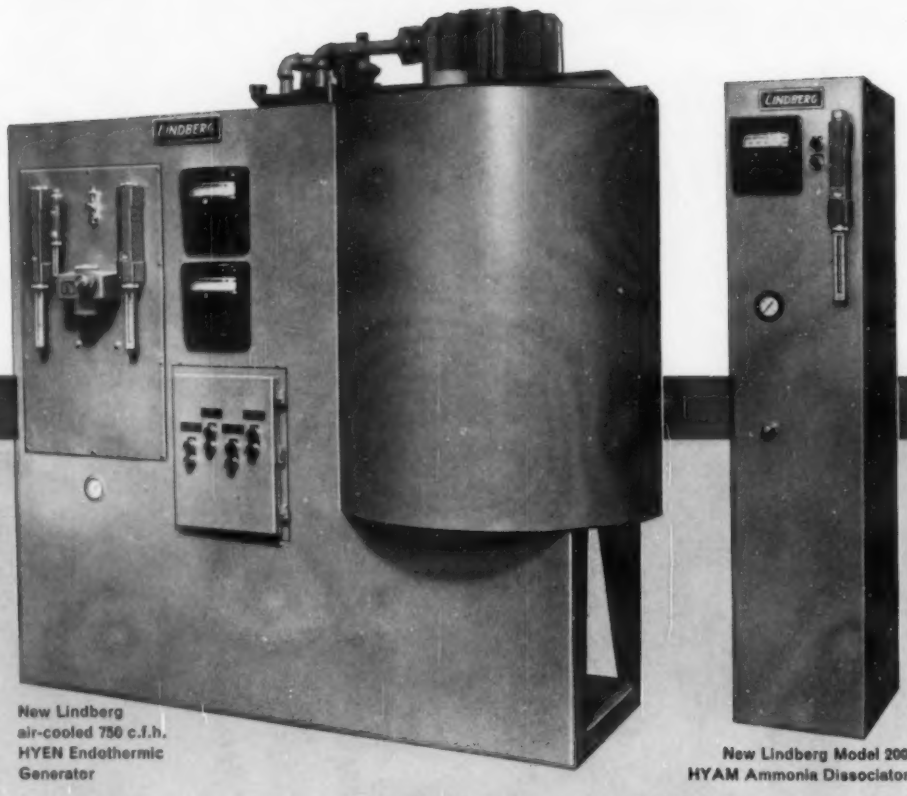


There's one sure way

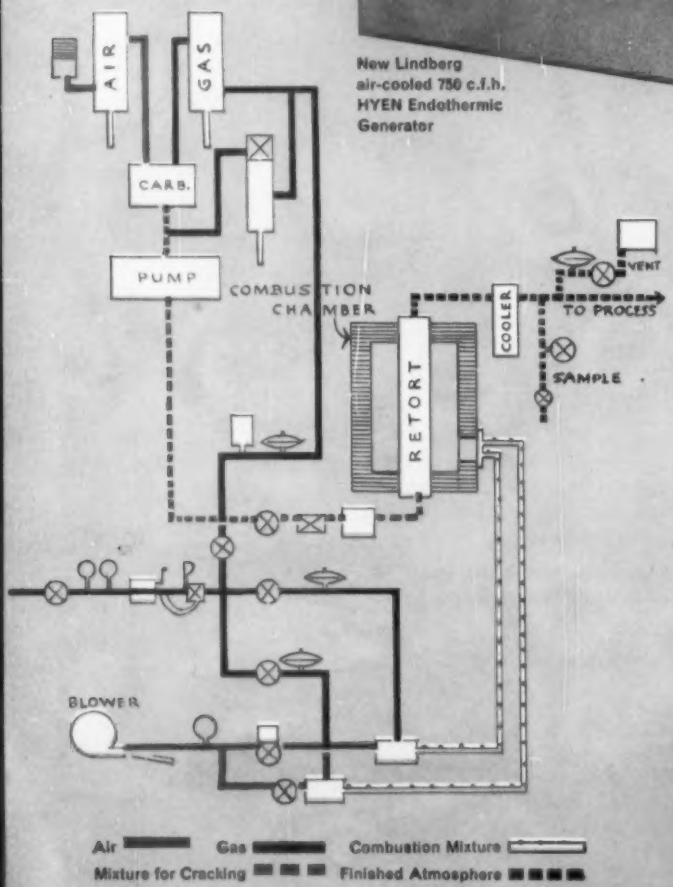
You'll see these brand-new Lindberg Generators at the Metal Show



New Lindberg air-cooled 750 c.f.h. HYEN Endothermic Generator

New Lindberg Model 200 HYAM Ammonia Dissociator

Schematic Flow Diagram of Lindberg HYEN Generator



To be shown for the first time are two Lindberg generators designed and engineered for improved efficiency and economy in the production of metallurgical atmospheres.

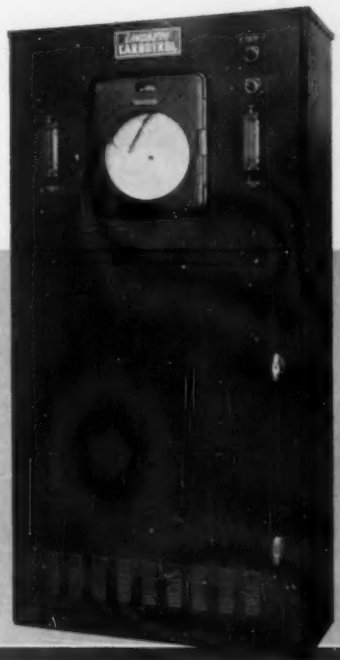
The new Lindberg HYEN ENDOTHERMIC GENERATOR is a fully automatic process for producing low cost protective atmospheres for bright hardening, bright annealing or bright brazing of steel totally free from decarburization or carburization. It will provide significant production economies, more precise operation and lowered maintenance costs. This new unit is *air-cooled*, eliminating the expense and trouble of water cooling systems. The HYEN Generator is available in 200, 500, 750, 1000 and 1500 c.f.h. capacities and larger sizes can be provided if desired.

The Lindberg HYAM AMMONIA DISSOCIATOR, Model 200, is a brand-new development offering a combination of efficiency, capacity and compactness never before available to industry. The unit requires *less than 2 square feet of floor space.* Operating at capacities up to 200 c.f.h., it is *guaranteed* to maintain or exceed 99.95% dissociation efficiency (at 150 c.f.h. 99.99% efficiency is guaranteed). It is particularly designed for pilot plant applications, research and development, where high purity of atmosphere is required.

LINDBERG
heat for industry

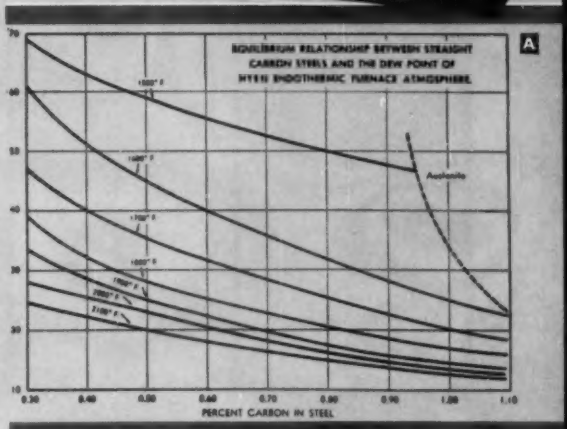
to get the right information on methods and equipment for producing and controlling

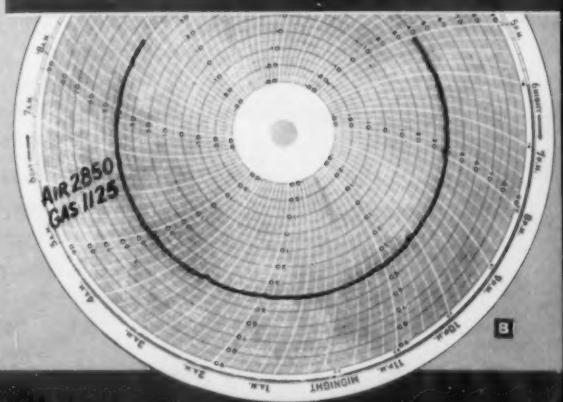
metallurgical atmospheres



Lindberg Carbotrol available for either dew-point or CO_2 infra-red control systems

A—Dew point equilibrium curves for use with Carbotrol have been established by Lindberg for types of steel and temperatures involved. B—Typical graph of Carbotrol performance. Note consistency of control.


A
EQUILIBRIUM RELATIONSHIP BETWEEN STRAIGHT CARBON STEELS AND THE DEW POINT OF HYCO ENDOTHERMIC FURNACE ATMOSPHERE
Austenite
PERCENT CARBON IN STEEL



Talk it over with Lindberg in Booth No. 706 at the Metal Show

Because of the importance of metallurgical atmospheres in metal working we are giving the subject major emphasis in our exhibit at the Metal Show. Visit us there and you'll be able to learn about all the latest developments in methods and equipment for producing and controlling these atmospheres. You'll find us well qualified to offer authoritative advice in this field because we've pioneered in it.

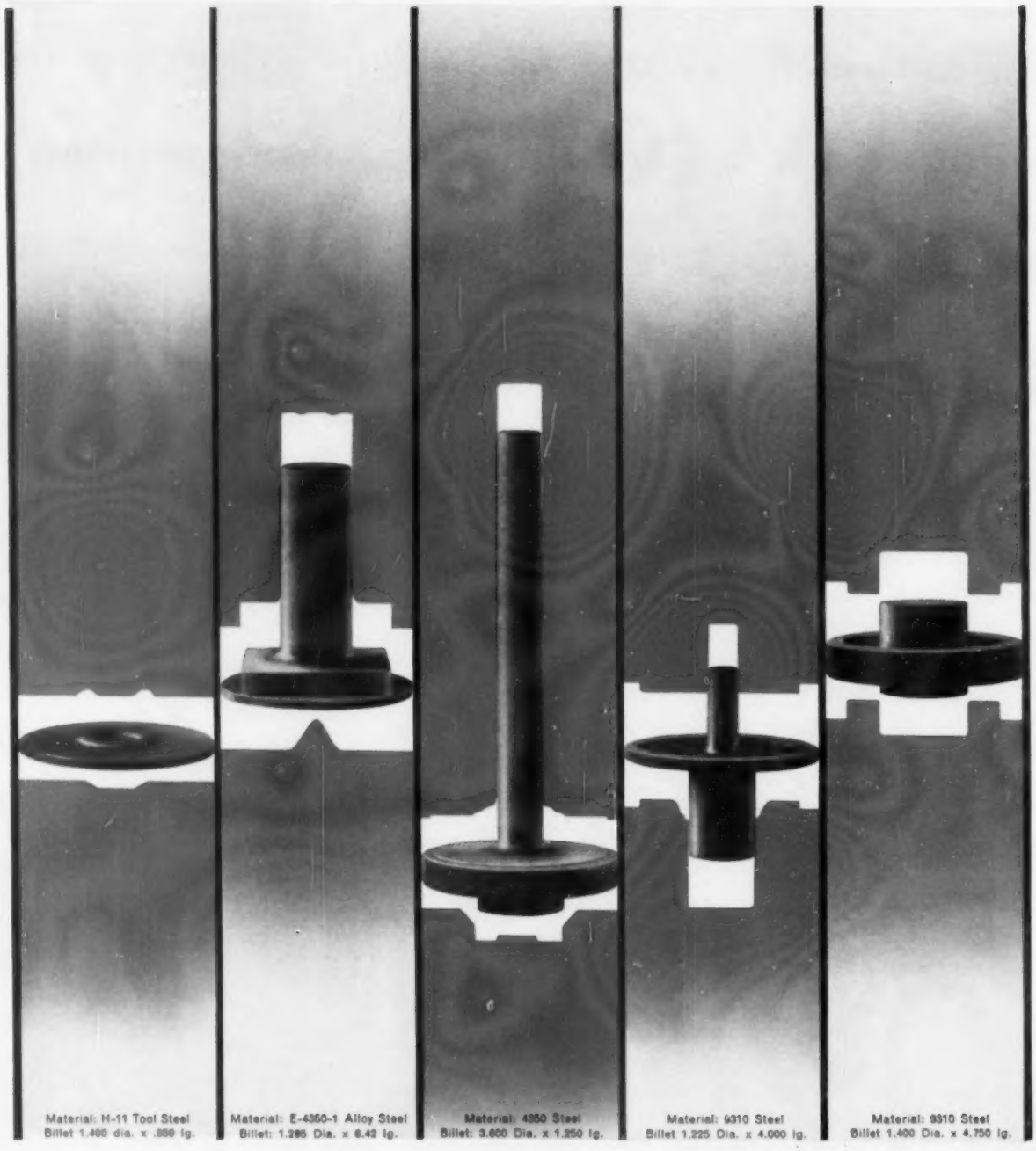
In equipment, the first endothermic atmosphere generator was developed by Lindberg many years ago. Through the years generators for varied types of metal treating atmospheres have been developed, including units for exothermic, dissociated ammonia and inert atmospheres. And we have kept adding refinements and improvements to set continually higher standards of efficient and economical performance.

Years ago, too, Lindberg designed the first equipment for controlling metallurgical atmospheres, the Lindberg Carbotrol. For this, Lindberg research also created dew point equilibrium curves to establish proper atmosphere values for types of steel and temperatures involved. The Carbotrol automatically controls these values. It is also available incorporating the new CO_2 infra-red system of control. Since Lindberg makes both types we are in an ideal position to recommend the method most suitable for your specific processes.

When you visit us at the Show you'll also be able to get the latest information on Lindberg's complete line of heat treating equipment, everything from a laboratory furnace no bigger than a breadbox to a gantry type installation six stories high.

If you don't get to see us at the Show you can get full information on all Lindberg equipment from your local Lindberg Field Engineer (see your classified phone book) or write us direct. Gas Process Division, Lindberg Engineering Company, 2447 West Hubbard Street, Chicago 12, Illinois.

Los Angeles plant: 11937 S. Regentview Avenue, Downey, California. In Canada: Birlefco-Lindberg Ltd., 15 Pelham Ave., Toronto 9, Ont. Also, Lindberg plants in Argentina, Australia, England, France, Italy, Japan, Spain, Switzerland and West Germany.


Material: H-11 Tool Steel
Billet 1.400 dia. x .880 lg.
Material: E-4350-1 Alloy Steel
Billet: 1.285 Dia. x 6.42 lg.
Material: 4350 Steel
Billet: 3.600 Dia. x 1.250 lg.
Material: 9310 Steel
Billet 1.225 Dia. x 4.000 lg.
Material: 9310 Steel
Billet 1.400 Dia. x 4.750 lg.

High-Energy Rate PRODUCTION ABILITY in one dynamic stroke! In this advanced, highly technical field, DYNAPAK high-energy rate metalworking equipment maintains consistent leadership through proven production ability. In support of this recognized position, illustrated above are forgings from BENDIX CORPORATION-UTICA DIVISION, where DYNAPAK is demonstrating its performance reliability in day-after-day production runs. DYNAPAK one-shot forging, extruding and metals compaction equipment increases savings, improves metal properties and reduces waste material. Closer tolerance controls, and the low micro finish of the "as forged" parts, are distinct advantages in DYNAPAK metalworking machines. Conventional or exotic materials, simple or complex shapes . . . DYNAPAK has few limitations. DYNAPAK metalworking machines are capable of making a part — in one stroke — that can be put to use with little or no machining. Apply DYNAPAK to your metalworking operations — it's the only *really new* proven concept in the industry.

Write for complete information to: Advanced Products Department, P.O. Box 6231, San Diego 6, Calif.

GENERAL DYNAMICS | ADVANCED PRODUCTS DEPARTMENT

Let's Get Organized!

Organization is a necessary prelude to accomplishment. By this time your chapter programs are, on paper at least, well organized and well underway. But often there's a big gap between progress on paper and profitable performance. Getting "everything lined up" is not the same thing as getting a job done.

Getting the job done—having a successful and productive year in your chapter—calls for real effort on the part of everyone associated with your chapter.

If you are a chapter officer, you have the job of making sure that plans are carried out. If you are not an officer, your participation in committee work, in chapter programs and your support, by personal attendance, at chapter meetings are essential to your chapter's progress. If at the end of this year your association with ASTME has done nothing for you, you have probably done nothing for ASTME. For it is precisely those who contribute their time, talent and energies to ASTME in the greatest amounts who derive the greatest benefits from ASTME membership.

"Getting organized," then, means something to every member, including you, whether or not you are a chapter officer or committeeman. Organize your work so that you have time to attend meetings and take part in special chapter projects. Organize yourself so that you can make greater contributions to industry.

The few minutes per week that you spend on Society activities may not seem like much to you, but the total man-hours that could be profitably involved if each ASTME member devoted just one hour a week to work for ASTME and its planned objectives is impressive. One hour a week times, say 36 weeks per year (take the summer off if you want to) times 41,000 members equals nearly a million and a half man hours—a tremendous investment in the economic future of America.

This organized investment in time can pay off handsomely. Some of the benefits are greater manufacturing know-how, achievements in the field of manufacturing beyond number and all the other benefits that accrue from having a stronger, more active Society.

Your Society is committed to a position of leadership. It can only retain that leadership with your support. And that support, it goes without saying, is up to you. When you "get organized," your engineering organization gets ahead.

And so do you!

W. Moreland

PRESIDENT
American Society of Tool and Manufacturing Engineers

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Here's how the LARGEST BUYER OF STAINLESS can solve your buying problems... save you money

If you think of Ryerson as a *supplier* of stainless steel, you're only partly right. Because Ryerson is also a buyer of stainless—the nation's largest buyer—and this fact holds important advantages for you.

If your usual requirement can be met from stock, then Ryerson offers you these problem-solving advantages:

1. As the nation's largest buyer of stainless, we, of course, have the nation's largest stocks with 2351 different types and sizes available for immediate shipment.
2. In our biggest-buyer relationship with the mills, we have ready access to the knowledge and skill of leading producers. So this help is readily available to you through Ryerson, coupled with the practical application experience of our own stainless specialists.

If you are generally a direct mill buyer here's how you gain:

1. At no extra cost you can place your mill orders through Ryerson.
2. You deal conveniently with local Ryerson men who take full responsibility for meeting your requirements.
3. As the largest buyer, we have a knowledge of sources and position with them that few other buyers can command. You eliminate source searching, paperwork, expediting, etc., when you concentrate purchases on one order to Ryerson.

So whatever the size of your requirement, whatever the specification, you can count on Ryerson for fast, dependable delivery. And tight Ryerson controls assure consistent high quality of all shipments. When you need stainless, call our nearest plant.

RYERSON METALOGICS

JOSEPH T. RYERSON & SON, INC., MEMBER OF THE REPUBLIC STEEL FAMILY

STEEL · ALUMINUM · PLASTICS · METALWORKING MACHINERY

getting results from

COMPANY RESEARCH PROGRAMS

By Maurice Nelles
Executive Vice President
Scientia Corp.
Santa Barbara, Calif.

When company research programs are well-managed, they can pay off tremendously in terms of new and profitable products and processes. Unplanned or haphazard research efforts, however, are a liability rather than an asset. The author, a noted research executive, shows how research programs can be organized for optimum results.

THE SUCCESS of any manufacturing company depends on the success of its research efforts. An investment in research can pay a thousandfold return. Any company, small or large, needs research in order to survive, in order to continue to sell its products in a highly competitive market place.

The term "research" as used here does not refer to a hunting expedition. It refers to a well-planned and well-coordinated effort to develop new—and salable—products and processes.

There are hundreds of well-equipped and well-staffed research departments in this country that produce little that is of direct value to their company. As a result, some company presidents seriously ask whether research is an asset or liability.

When a research department is not developing new products and processes that add to company profits, the chances are that company leadership is at fault. The research effort, like any other company activity, requires leadership and it must be well-planned and put on a definite time schedule to obtain worthwhile results.

This leadership must come from the top. The company management must take the initiative where research is concerned. No company president would give his research director several millions of dollars and tell him to putter around in the laboratory

for a year, and yet many companies do just that when they fail to indicate just what research results are needed for corporate progress.

Research Director: Key man in the research effort is the research director. An effective research director must be a master of research techniques and he must know how to evaluate and fully utilize the capabilities of the scientists and engineers who work in his department. As an individual he should have successfully performed research along the lines that the company is interested in and he should have proved ability to plan and organize research programs.

Some companies hire professional administrators as research directors, on the theory that such individuals will have a fresh point of view and will be able to communicate with top management better than a scientist or engineer. Unless a research director is a scientist or engineer, however, he cannot possibly understand the research projects that he is supposed to be directing, or even understand the written reports that are submitted by the scientists and engineers that he supervises.

Scientists and engineers can learn administrative work. Management courses offered by colleges and universities can help them to develop their managerial capabilities in a short time. It is next to impossible for a person who has been educated as a lawyer, accountant or administrator to develop the understanding of science and engineering that is required of a research director.

Size of the Department: The size of a research department depends on the nature of the problems it tackles and the speed with which results are desired. When a moderate-sized research department is formed, diverse talents should be available to the director. The prime talent of everyone in the department should be for research. Skills in various specialties are merely supplementary. If an assistant research director is needed, his scientific and engineering background should supplement that of the director. If the work of the department is electromechanical, the research director could be an electrical engineer, for example; the assistant could be a mechanical engineer. Similarly, the abilities of other scientists and engineers in the department should be complementary.

Selecting Research Workers: Experimenters make the best researchers. When selecting a staff, the research director will keep this in mind. The drive to experiment shows up in early childhood and continues through life. Most—but not all—of the men who have made real contributions to science and technology have been closely associated with laboratory operations. The laboratory is a place where scientists and technologists run experiments that they cannot run in their heads or on a piece of paper.

The best way to learn whether or not a person is a good researcher is to ask him what he has created. If his past research results have been of value and his experience is along lines that are of interest to the company, he should work out well.

The specialties of the research people hired will depend on the nature of the research problems of

About the Author

Maurice Nelles, who earned his Ph.D. at Harvard and D.Sc. degree at the University of South Dakota, has nearly 30 years' experience as a research engineer and executive. He has been associated with Lockheed Aircraft as a staff assistant, taught engineering at several colleges and universities, been director of research for Borg-Warner Corp., director of research for Technicolor Corp., vice president-engineering for Crane Co., and is currently executive vice president of Scientia Corp. During World War II, Dr. Nelles was chief engineer of the Office of Production Research and Development—a group that did much to accelerate much-needed manufacturing research during the war years. He is an ASTME member.

His research talents have been applied to oceanography as well as industry. He designed and built a successful underwater camera in 1951 and has been in charge of deep-sea scientific expeditions.

Dr. Nelles is the author of numerous articles on management, research and engineering and is in demand as a speaker on these subjects. One of his current interests is the formation of a National Technical Foundation, similar to the National Science Foundation. The purpose of this foundation will be to accelerate manufacturing research in the United States. Regarding the importance of the proposed Foundation, Dr. Nelles says:

"The Soviets have started an all-out offensive to enslave us by beating us at our own game—production. Mr. Khrushchev has repeatedly warned that our guided missiles will rust on their launching pads and our grandchildren will be under Communist rule because the Communists will have better products and processes than ours in the world markets. It is of extreme importance that we reorganize our manufacturing research efforts and guide the Government into a vigorous research program."

Readers who are interested in the establishment of a National Technical Foundation are invited to write to Dr. Nelles, in care of this magazine.

What Company Managements Need To Know About Research

- **Research is not a hunting expedition. It is a well-planned and well-coordinated effort to develop new—and salable—products and processes.**
- **When a research department is not producing new products and processes that add to company profits, chances are that company leadership is at fault.**
- **The research director must be a master of research techniques . . . and he should be able to plan and organize research programs.**
- **Experimenters make the best researchers. Good researchers are nonconformists and cannot be expected to conform to rules that are established for clerks.**
- **Most research can and should be put on a time schedule. If a proposed project cannot be time-scheduled, it is probably not ready for an all-out effort.**
- **If a company is at a serious competitive disadvantage, it cannot afford the luxury of a small research effort.**
- **For almost every company there is a point where additional research expenditures will bring disappointing results.**
- **Corporate suicide results when research expenditures are based on a percentage of profit. Research is needed most when profits drop.**

the company. If there are 20 or more research workers in a department, some will be generalists, some will be specialists, with generalists predominating. A few will be "long-hairs;" others will be practical men. The mix will depend on the problem but all workers are equally important to successful research.

Good research men are nonconformists and cannot operate as research men and conform to rules and patterns of behavior that are established for unskilled laborers, clerks and production personnel. They are, however, anxious to conform to rules that permit them to work effectively.

Research workers must have access to libraries and must be free to attend scientific and technical meetings. They must have authority to obtain equipment and materials not normally in use in the plant. They should have access to the laboratory at all hours—there are few experiments that last just eight hours.

Organizing for Research: A company research department, like the company itself, must be well-organized to achieve profitable results. Some research departments are organized by project; others by function. Both types of organization are successful. In the project organization, everyone who is working on a specific project reports to one man, who is responsible for seeing to it that the project is carried to a successful conclusion. In the function type of organization, people report to an individual who heads up a group of specialists, such as physicists. This individual is responsible for the aspects of the project that pertain to his specialty. The latter type of organization requires more follow-up by research management but better and faster results can usually be obtained because a greater amount of experience can be brought to bear on specialized aspects of the project.

Choosing a Project: No research director should take upon himself the responsibility of determining what company research projects should be undertaken. That decision should be made by key executives of the company. If the proposed project involves a new product, the chief sales executive must affirm that the product will be salable. The engineering executive must pass on engineering feasibility. The manufacturing executive must agree that the product can be made at a cost that is in line with a price proposed by the sales executive. And, of course, the chief executive of the company must take into consideration overall company plans and the availability of money for development, tooling, facilities and marketing.

Research proposals can originate anywhere in the company. Most proposals may originate in the sales and manufacturing departments. Sales personnel are in the market place and they are in the best position to know customers' present and future needs. Proposals for new and improved processes will probably originate in the manufacturing de-

partment, since people in that department will know which processes are slow or expensive. Projects will also originate in the research department itself. Research people are in a position of knowing of advanced developments in science and technology. They can see possible applications of these developments in their company's products and processes.

Proposals for research projects should be as detailed as possible and they should be clear and understandable to management. If a proposal is highly technical, it should contain enough explanatory material so that nontechnical members of management can appreciate the importance of the new knowledge to be gained. The fact that a proposal is new is a signal for special care in its presentation.

Time Schedules: Most research can and should be put on a time schedule. If a proposed project cannot be time-scheduled, it is probably not ready for an all-out research effort. Research men usually like tight time schedules; tight scheduling indicates that management has confidence in the research department and that its work is important. The research department should, however, agree to a schedule before work is started. An impossible schedule gives research men the feeling that they have failed before they start.

Research progress should be evaluated weekly in most cases. With weekly reports, the reasons for arrested progress can be evaluated and new plans made without loss of time.

Communications: Corporate executives sometimes complain that it is difficult to keep in touch with the activities of the research department. It must be recognized that the products and processes being developed by the research department today will be in the market place tomorrow. The need for secrecy is obvious. Information about research proposals and projects should be restricted to those within the company who have a need to know about them.

An absolute minimum number of people should participate in decision-making when research proposals are being studied and when projects are in their early stages. Initially, only corporate officers should be informed. As a project becomes active, key managers in the company will need to know something about it. The next group to be informed will be the engineering department—usually when there is a need for its services. Manufacturing and marketing specialists will be called in when the time for manufacturing and marketing planning has arrived.

In the preliminary planning stages, communication will be by word of mouth and the minutes of the corporate planning committee. Later the plans will be detailed and given to those who should have them. Progress will be reported by the research director in writing and his written reports will be supplemented by verbal reports to top management. In the later stages of a project, interdepartmental groups will be involved and they should meet periodically and keep careful minutes. These will help top management to keep in touch with progress.

Research Budgets: If a company is at a serious competitive disadvantage, it cannot afford the luxury of a small research effort. Only those companies having a good profit position, having a pantry full of new products that can be put onto the market at any time, and having incompetent competitors, can afford to ignore research.

When a company already has a research program, it may be tempted to spend additional money on research, hoping to get a greater return. Such proposals should be studied carefully to see if that return will materialize. There is a point for almost every company where additional research expenditures will bring disappointing results—a point of diminishing returns.

Many companies budget research as a percentage of sales. This is wise if the budget is on a long-range basis and if it is not assumed that the money has to be spent when sales are made. A logical method is to put the returns from a percentage of sales into a fund that can be spent for research when necessary. The sales price of a product should contain an item for depreciation of the profitability of the product. This sum should be accumulated to develop a replacement or to expand the product line.

Some companies have budgeted research expenditures as a percentage of profit. This will ultimately lead to corporate suicide. Low profits clearly indicate that the company is not being managed effectively. When profits drop, it is time to make funds available for research to provide more profitable products and processes.

If research is well-managed, the returns from research investments will be great—they should be between a hundredfold and a thousandfold. They must be at least twenty-fivefold to pay for engineering, tooling, marketing and other expenses. The return of investment should be figured on the basis of the expected life of the product or process up to a certain number of years—say five years.

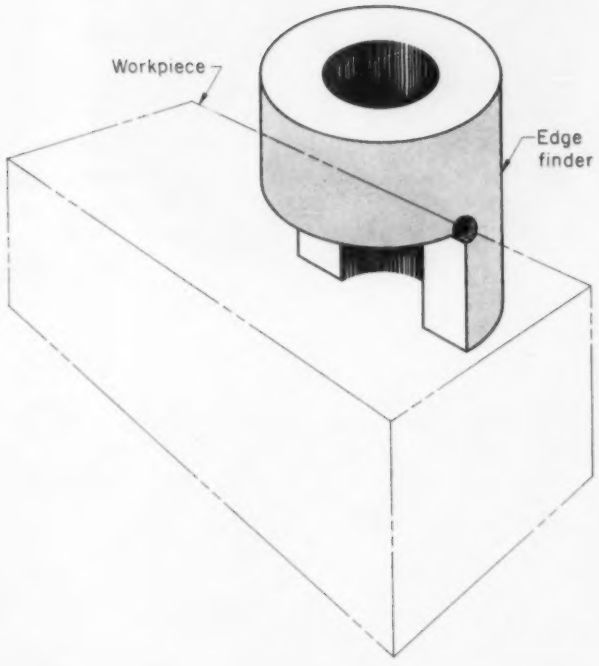
Good research results and high rates of return on research investment can be realized only if company management sets up definite research goals and gives the research department the personnel and support it needs to reach those goals. Research, competently carried out, is an asset, not a liability. It is not an insurance policy that can be ordered by telephone or purchase order. It is a live, vital part of management that must be kept in shape like any other part of the corporate machine. When it is, the rewards are great.

Gadgets — Ingenious Devices And Ideas

Cylindrical Edge Finder

Workpiece edges can be located quickly and accurately with this variation of the conventional "rocking chair." Both the inside diameter of the finder and the slot are precision ground, the vertical edge of the slot being ground on a diameter of the hole. Thus, by placing the finder on the edge and indicating the hole, the operator can place the axis of his machine spindle in the plane of the workpiece edge.

James Power
Lincoln, Neb.



Don't Forget Your Gadgets Contest Entry

The 1961 Gadgets Contest is underway. It provides you with an opportunity to win a prize while showing off that pet gadget idea of yours.

Entering the Contest is simple. Just send in a drawing and a brief description of your idea, telling us what it is, what it does and how it works. Don't worry about the quality of your drawing or the gloss on your literary style. We'll take care of the details. These are the simple rules:

- **Contest is open to ASTME members only.**
- **Entries must be limited to 500 words.**
- **Sketches in lieu of finished drawings are acceptable.**
- **Entries will be judged by the Editorial Committee on the basis of originality, conciseness and clearness of presentation.**
- **Prizes: First prize of $100; two second prizes of $50; four third prizes of $25; and awards to all close runners-up.**
- **Contest closes Dec. 31.**

Send your entry to The Gadgets Editor, 10700 Puritan Ave., Detroit 38, Mich.

Modified Chuck Provides Repetitive Accuracy

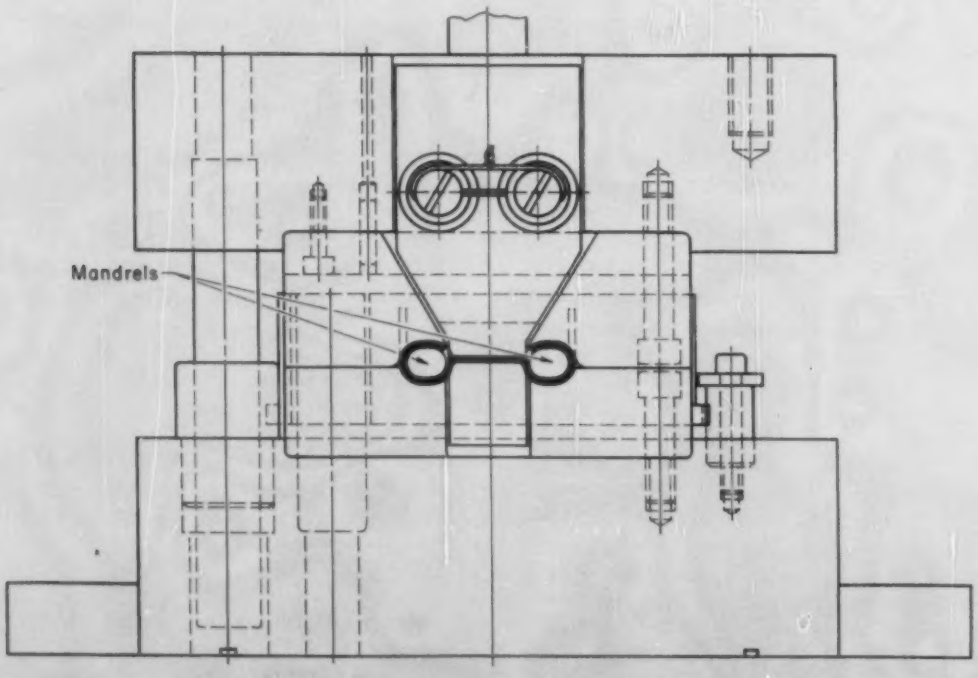
Gears and other difficult-to-hold objects can be easily and accurately machined through use of the modified chuck illustrated. Essential components include slides machined to mate with the chuck adjusting screws, and four soft-steel cylinders. Spacers between each cylinder and slide key the individual assemblies in place.

When the cylinders have been screwed to the slides, a light machining cut is taken to obtain requisite diameters. Parts can then be checked or removed merely by tightening or loosening one jaw. To preserve accuracy, the same jaw should be used consistently.

C. Gibbons WO 2
R. C. A. F. Station
Greenwood, N. S.

Die Has Two-Dimensional Mandrel Movement

Designed to complete a closed forming operation, this die utilizes mandrels that move in two dimensions. When the die is open, the mandrels are in an elevated forward position. During die closure, the mandrels, depressed by spring pressure, advance ahead of the forming punches.

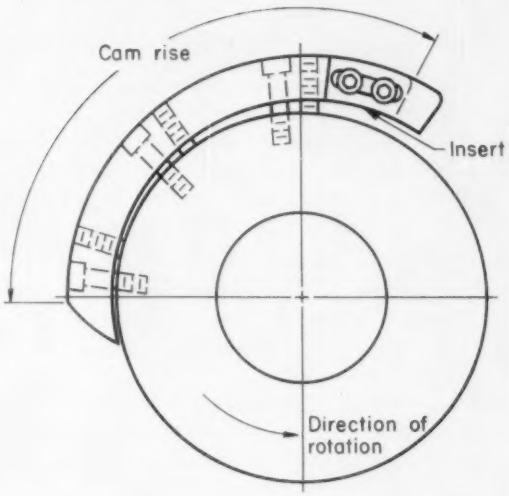


Gadgets

Adjustable Cam Simplifies Machine Setup

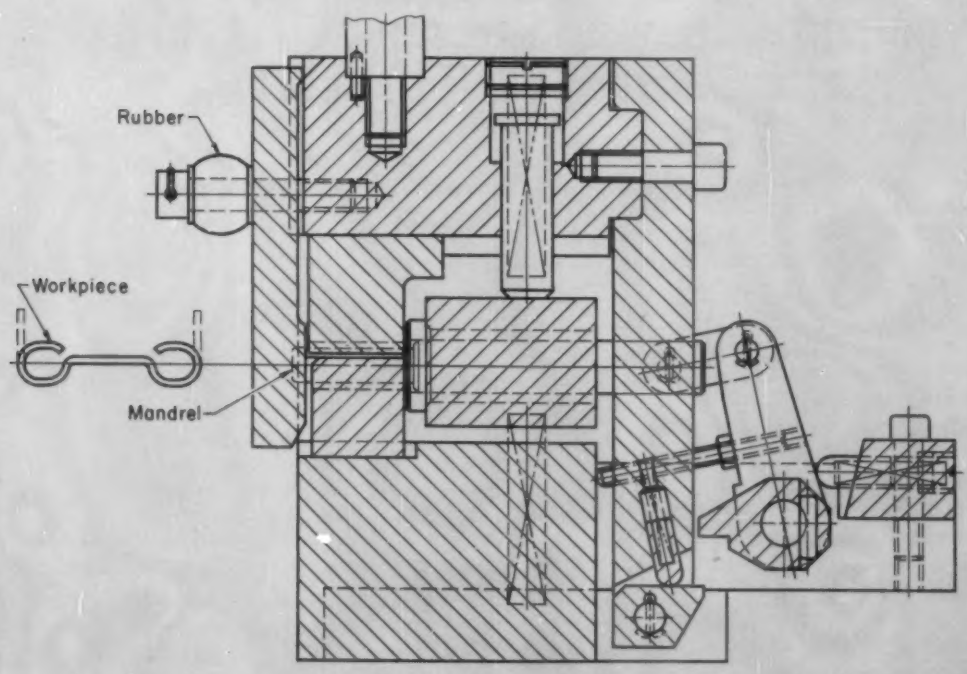
In older machines accurate cam setups are often difficult to effect because of excessive backlash and looseness of moving parts. The cam design illustrated simplifies setup on such machines by providing operators with an adjustable cam surface. Adjustments for roller rise and fall are made with setscrews, locking action being provided by socket-head screws. Adjustments for length are obtained with a movable insert.

John M. Breen
Pittsburgh Chapter



As the die opens, the two-dimensional mandrel movement takes place. First, the mandrels rise on spring pressure and then retract by the action of a hook that activates a linkage system. In retracting, they effectively strip the finished workpiece. After stripping takes place, spring pressure on the linkage system returns the mandrels to their forward position.

Donald A. Bruno
Racine, Wis.



Gage Inspects Large Diameters

Diameters too large to check with conventional equipment can be accurately measured with this gage. In use, the gage is mounted on a cylindrical component as shown and the distance Y-X is measured and substituted in the formula

$$D = \frac{(C/2)^2}{(Y-X)} + (Y-X) - 2R$$

In this equation, D is the diameter of the workpiece, and C, Y and R are constants of the gage.

Use of this gage is based on the principle that the products of the segments of two chords intersecting within a circle are equal. In practice, the diameter actually measured is that of a circle running through the centers of the gage rolls, concentric to the workpiece. When this diameter has been established, the workpiece diameter can be obtained by subtraction of $2R$ from the measured circle.

The two chords used in measuring the outer circle are C and a diameter which intersects C at 90 deg. The product of the segments of C are $(C/2)^2$. Product of the segments of the diameter are S and Y-X. S is unknown, but because the products of the segments are equal, S can be found by the equation

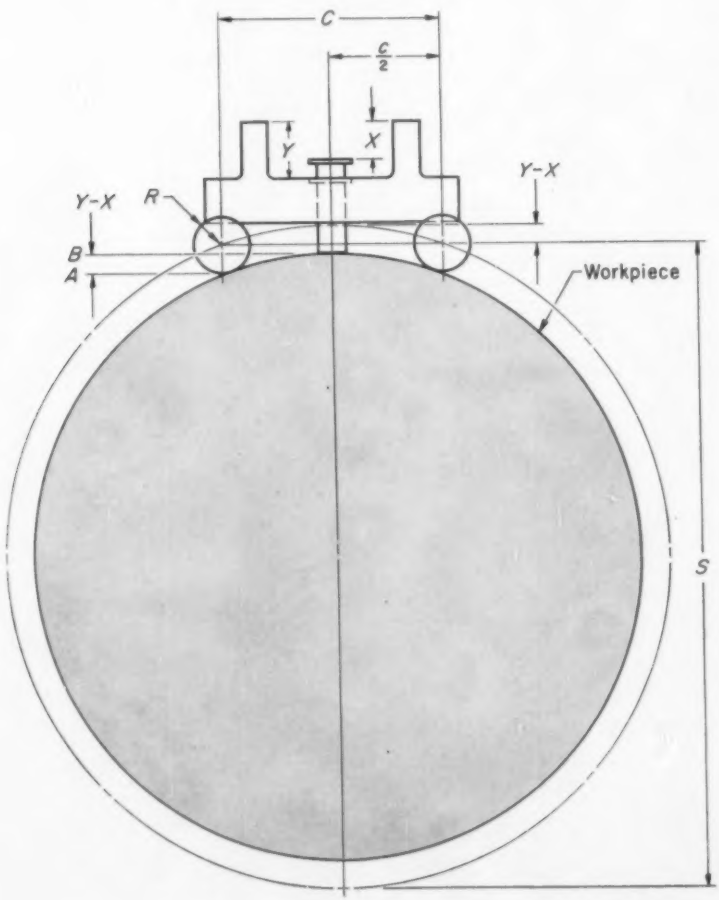
$$S(Y-X) = (C/2)^2$$

This equation can then be transposed to read:

$$S = \frac{(C/2)^2}{(Y-X)}$$

When S has been found it can be added to $(Y-X)$ to obtain the diameter of the circle through the centers of the rolls. It is then necessary only to subtract twice the radius of the rolls from this amount to obtain the workpiece diameter.

Louis Kasper
Philadelphia Chapter



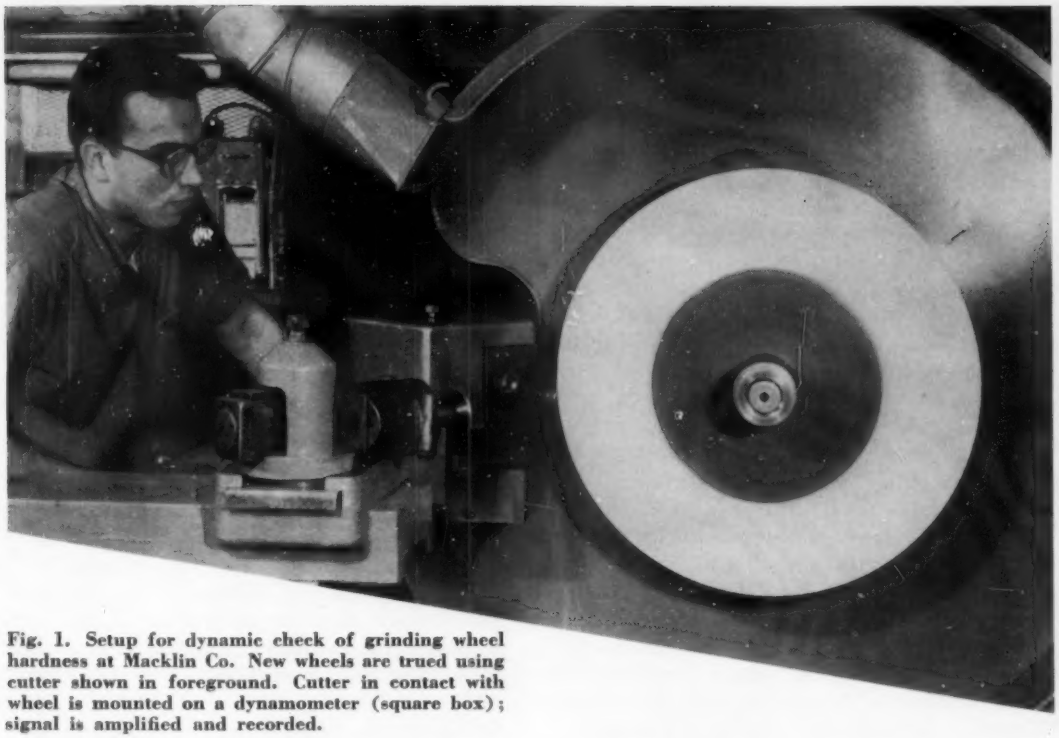


Fig. 1. Setup for dynamic check of grinding wheel hardness at Macklin Co. New wheels are trued using cutter shown in foreground. Cutter in contact with wheel is mounted on a dynamometer (square box); signal is amplified and recorded.

dynamic wheel hardness testing

... breakthrough in grinding technology

By T. W. Black
Senior Associate Editor

With a 45-second check, the performance of a new wheel in service can be readily predicted by using a new dynamic test method. Developed to provide a reliable method of checking grinding wheel hardness, the test may cast additional light on the fundamental nature of the grinding process itself.

HARDNESS OF A GRINDING WHEEL is one of the major factors that governs grinding efficiency and surface finishes. In general, "hard" wheels give best results when grinding soft materials; "soft" wheels are preferred for grinding hard materials.

What Hardness Is: The term "hardness" as applied to grinding wheels does not refer to the physical hardness of the abrasive grains or the bond material. The same types of abrasive grains and bond materials are used for both hard and soft wheels. Rather, hardness refers to the ability of the bond to hold the abrasive grains. This property depends on the relative amounts of abrasive grains and bond in the wheel. With a high bond-to-grain ratio, and high unit density (high hardness), high grinding forces are required to tear out individual abrasive grains. With a lower ratio (a soft wheel), grains are torn out by relatively low forces.

Grinding is a chipmaking process in which in-

dividual grains of abrasive act as cutting tools. When a wheel is freshly dressed, the individual grains are sharp and cutting efficiency is at a peak. As grinding proceeds, individual grains become dull. Higher grinding forces are needed to cut with these dull tools and there can be a considerable amount of frictional heating—heating that can make size control difficult. A hard wheel may require frequent dressing to remove dull grains and expose sharp cutting edges. This frequent dressing can be time consuming and may shorten wheel life. With an extremely soft wheel, on the other hand, grains may be torn out of the wheel while they are still sharp enough for efficient cutting. Again, wheel life is shortened.

For any given set of cutting conditions and grinding machine, there is one degree of wheel hardness that gives optimum finishes and efficiency. When selecting a wheel, the tool engineer relies on manufacturer's recommendations, handbook data and his own past experience on similar jobs. Naturally he tries to specify a wheel that is neither too hard nor too soft for the operation.

Selecting a wheel of the correct hardness is complicated by the fact that the effective hardness of a wheel is influenced by the machine on which it is used. A wheel that acts "hard" on one machine may act "soft" on another machine. Actually, four variable factors influence hardness: the terminal dullness of individual abrasive grains, the elastic properties of the bond that supports individual grains, the elastic properties of the wheel itself and the combined elastic properties of the entire machine-wheel-workholder-workpiece system. It is this last factor that causes the same wheel to perform differently on different machines.

Wheel hardness then, is a relative, rather than an absolute value. And, because of the elastic factors, effective wheel hardness—a measure of how a wheel will perform in production—must be determined dynamically.

Static Testing: Until recently, there has been no method of dynamically testing wheel hardness, other than running the wheel under controlled production conditions for a long period of time. Wheel manufacturers have had to rely on static tests to determine the hardness of new wheels. In one static test method, wheels are checked using a diamond or steel penetrating tool in much the same way that metals are checked for hardness. The depth of penetration gave a relative hardness figure. In another test method, the true frequency of the wheel is determined sonically. The true frequency is related to the modulus of elasticity of the wheel, from which relative hardness can be estimated. In a third method, the unit density of the wheel is determined, giving data that can be related to hardness. None of these methods takes cognizance of all of the elastic factors that are so important to wheel performance.

Dynamic Testing: Elastic factors are taken into account in a dynamic wheel hardness testing method developed in the Production Engineering Laboratory of the University of Michigan under the direction of R. O. Lane, head of the research department of

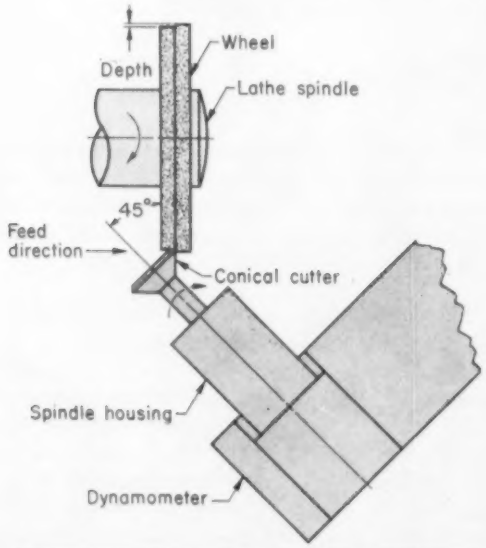


Fig. 2. Schematic diagram of test setup. Conical cutter, actually a crushing wheel, is fed across the face of the grinding wheel, crushing small amounts of abrasive in the surface of the wheel.

Wheel Hardness Values for Predicting Performance

Type of Wheel	Crushing Force, First Pass (lb)	Crushing Force, Second Pass (lb)	Dimensionless Hardness Number
48A46H8V6	18	2	111
48A46I8V6	24	3	125
48A46J8V6	40	14	350
48A46K5V6	62	32	515
48A46H5V6	41	15	366
48A60H5V6	50	22	440
48A80H5V6	90	50	555
48A60H8V6	40	10	250
48A60H8V6*	41	12	293
48A60H12V6	54	20	372
48A60H8V6*	56	25	446
48A60K5V6	87	50	575
84A46H8VMM	22	3	136
84A46L8VMM	40	12	300
C60K11B1268	108	92	850
C60L11B1268	134	108	810
DA60F9V2D	22	2.5	113
DA60G9V2D	28	5	178
DA60J9V2D	42	14	343
39C60I7V	26	4	154
39C60J7V	34	8	245
39C60K5V	72	40	555
32A46H8VBE	28	7	250

*Test on another wheel of the same specification.

Fig. 3. Signal from dynamometer is amplified and used to produce ink trace on graph, which is a permanent record of crushing force for each wheel tested.

the Macklin Co., Jackson, Mich. grinding wheel manufacturer. Macklin furnished development funds.

In the new test method, *Figs.* 1 and 2, the wheel is mounted on the spindle of a lathe. A conical cutter is drawn across the face of the wheel under test. The spindle of the manganese steel cutter is mounted on a two-component lathe dynamometer that is fastened to the lathe cross slide. The dynamometer measures forces both vertically and horizontally.

For testing, the cross slide is set for the desired depth and the cutter is fed across the wheel in either direction, crushing or cutting the wheel face. The surface velocities of the cutter and the grinding wheel are the same. Wheel speeds are comparable to those used in production and speed has little effect on the force measurements. During testing, the signal from the dynamometer is electronically amplified and automatically recorded on a strip of graph paper, *Fig.* 3. The ink trace on the graph is a record of the crushing force and can be read directly in pounds. With a hard wheel, crushing force is high; with a soft wheel, tested under the same conditions, crushing force is low.

The force recorded on the graph can be interpreted as being made up of three components—a crushing component, an elastic component and a packing component. Initial contact of the cutter with the grinding wheel under test is elastic. As forces build up, the individual grains are split or broken away from the bond. The magnitude of this force is determined by the strength properties of the bond and the number of grains in the zone of contact.

The existence of the elastic component can be deduced from the fact that there are few grains actually in contact with the cutter at any one instant. Stiffness of the entire system is substantially less than that of the individual grains in the wheel. The deflection of the system in building up a force sufficient for crushing may be several times the diameter of the grains that are broken out. In a laboratory test setup with a system rigidity of 7000 lb, total deflection was 0.010 inch when the crushing load was 70 lb. This load was required to crush the wheel at a depth of 0.006 inch and a feed rate of 0.070 ipr. Since the wheel could ride up and down no more than the depth of cut, the minimum elastic component was 28 lb.

All of the debris crushed from the surface of the grinding wheel must pass between the wheel and the cutter. This causes some interference between the wheels; consequently, some additional load—the packing component. The packing component is essentially elastic. It is confined to the crushing zone and has little practical significance except that excessive amounts of packing caused by large cuts would alter the shape of the surface of the crushing wheel and would reduce the sensitivity of force measurements to the elastic component. The packing phenomenon thus establishes upper limits on the size of cut when checking wheel hardness.

Applications: Data obtained in tests with the new method, *Fig.* 4, show that this method of evaluating grinding wheel hardness produces measurements that reflect the properties that are important in actual grinding. When a wheel is graded with the dynamic method, its relative performance in production can be confidently predicted—something that has not heretofore been possible because of the inherent limitations of static test methods.

The dynamic test method is already in use for inspection and quality control at Macklin Co., *Fig.* 1. Testing is done in conjunction with the wheel

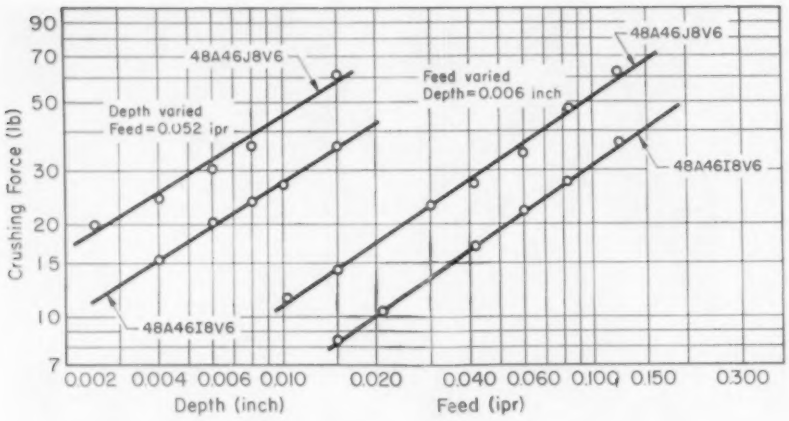


Fig. 4. Effect of wheel grade (hardness) on cutting force. Crushing force is greatest for hardest wheel under a range of depths of cuts and feeds.

truing operation and on the same machine. Total test time is about 45 seconds. Previously, hardness testing was a separate operation in which about ten penetration measurements were made at various points on the side of the wheel—an operation that took several minutes of operator time, plus the time and effort involved in moving wheels, which may weigh several hundred pounds, to the testing area. Adoption of the new method has thus effected labor savings, as well as giving a more reliable evaluation of wheel hardness.

A series of laboratory studies indicates the feasibility of establishing industrial standards for grinding wheel hardness with the new test method. In one approach, a two-pass procedure is used. The cutter is adjusted for a particular depth and feed rate, then fed across the face of the grinding wheel and the resultant force is measured. Next it is passed across the wheel again at the same feed rate and without changing the depth setting. Any residual elastic deflection from the first pass will cause further crushing on the second pass.

A number of 12 x 1 x 5 wheels were tested under the same cutting conditions with the two-pass procedure. First-pass and second-pass forces are shown in the table on page 84. The ratio of the average of the second-pass forces is divided by the average of the first-pass forces, then multiplied by 1000 to avoid decimal points. The resulting dimensionless hardness number is shown in the extreme right-hand column in the table. Maximum possible hardness is 1000. This scale could be used to develop industry-wide grinding wheel hardness standards.

Research applications are also possible. The test method may result in the development of a basis for predicting chatter conditions in grinding. It can also give information on the effect of machine rigidity on grinding behavior and it should be valuable for predicting differences in performance of the same grinding wheel on different grinding machines and under different grinding conditions. Thus the test method, which was developed to provide reliable wheel hardness measurements, may ultimately lead to a better understanding of the grinding process itself—an understanding that could pay rich dividends in productivity throughout industry.

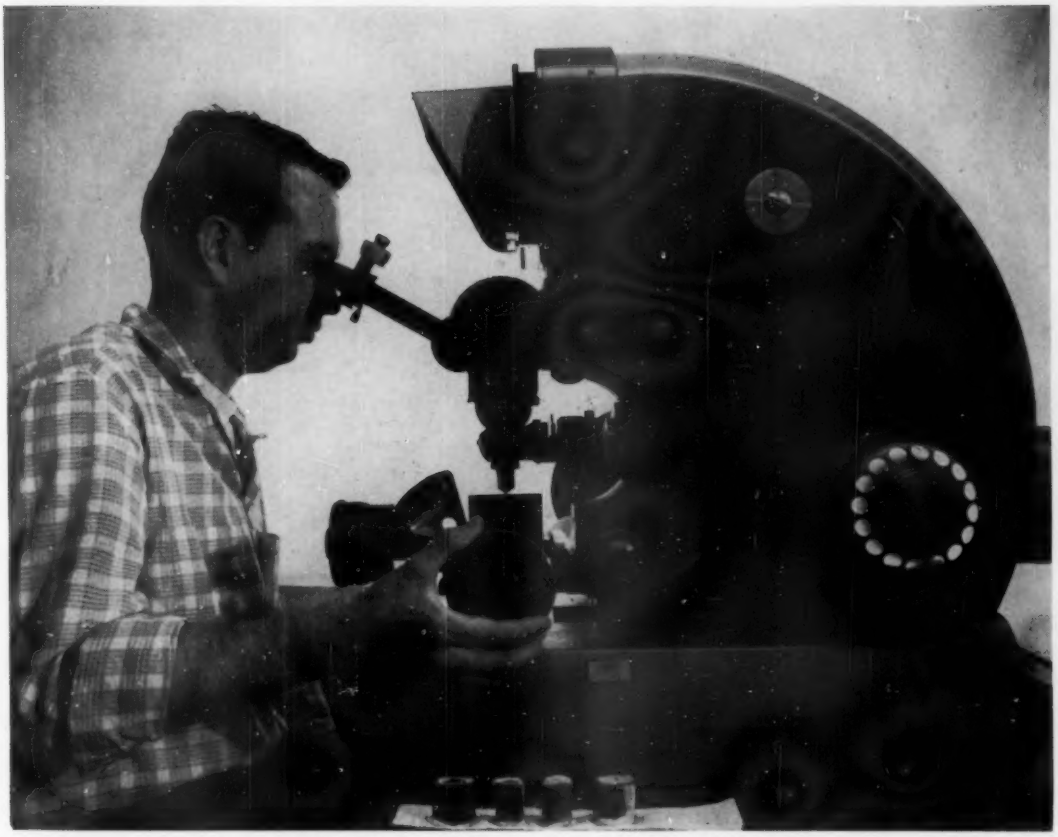
Too Many Steel Stock Sizes?

Manufacturers, distributors and users of ground tool steel stock agree that there are too many standard sizes and have recommended that they be reduced from over 700 to 332 sizes. This would be a solution to the problem caused by adding new items to meet increasing demands for the product —the problem of maintaining an adequate line of salable items.

The standard sizes recommended are listed in Simplified Practice Recommmendation R264-61, entitled "Standard Sizes of Oil-Hardenable Flat, Ground Tool Steel Stock." Published by the Commodity Standards Div. of the Office of Technical Services, U. S. Department of Commerce, the report lists sizes for 18 and 36-inch lengths and gives recommendations on materials, dimensional tolerances and surface finishes.

Surveys by the American Ground Flat Stock Assn. reveal that the 332 items will provide an adequate selection for all ordinary needs. It will account for more than 90 percent of sales volume. Hence, the reduction in variety will enable the trade to concentrate its services on the most useful items and avoid those which are superfluous or special.

Copies of the recommendation can be obtained by writing to the Superintendent of Documents at the U. S. Government Printing Office, Washington, D. C. They are 10 cents each.



High accuracy coordinate stage for this Zeiss Ultraphot Metallograph was designed using precision granite parallels for ways. Magnesium forgings are used for base parts because of extreme weight and space limitations imposed by basic machine design. Granite is stable and maintains its accuracy for the ways.

Tooling with Granite

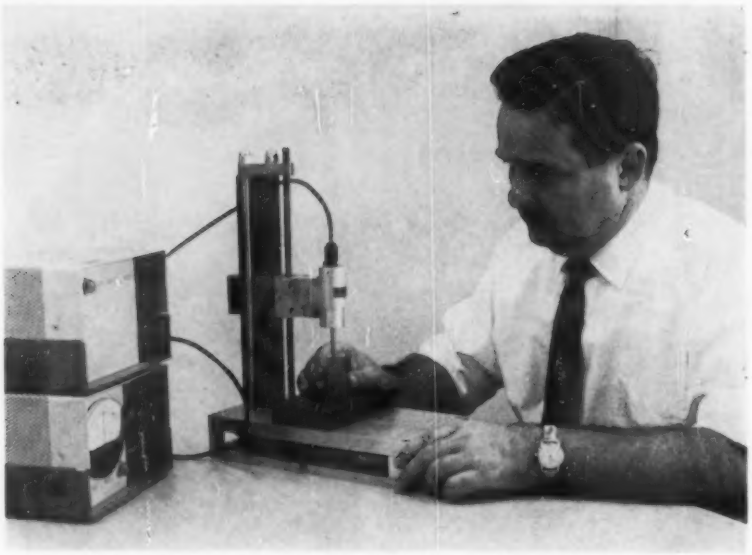
By V. E. Diehl
Manager
Physical Standards
Ampex Corp.
Redwood City, Calif.

Judicious use of this naturally stabilized material opens up exciting possibilities for critical applications in modern tool and machine design. Precision parallels and ways are readily adapted to instrument design.

MUCH has been written about the use of granite for surface plates and for their general accessories: parallels, straight edges and angle plates. Use of this material now opens up exciting possibilities for the modern tool and machine designer.

Demands of industry for better measuring methods and materials of greater stability for instrument bases led to the study of black granites for these precision parts. The resulting research led to the development of unusual equipment and helped alleviate the current "measuring pinch."

In designing tools and instruments using granites, it is wise to plan ahead as far as possible. All holes, slots, T-slots, chamfers, etc., should be located from reference surfaces, keeping holes a safe distance from edges ($1\frac{1}{2}$ x diam min) and avoiding extra



Home-made millionth comparator uses precision granite parallel anchored to granite base, forming the stand for Decker-Delta unit measuring system. A gear train in the subbase provides fine adjustments.

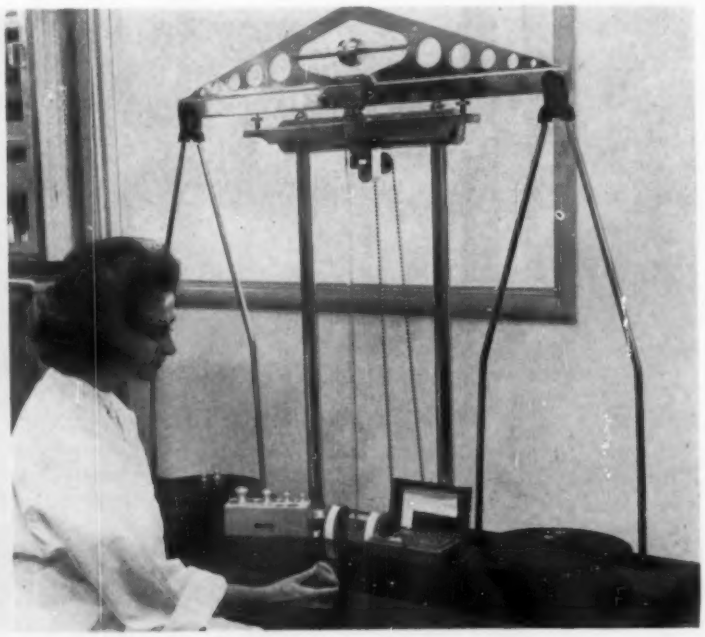
thin sections. The black granites* are approximately three times stiffer than ordinary granites, so if deflection is a problem, this should be taken into account in selecting the type most suitable. Ordinary granites are also more porous and are not as dense. They sometimes exhibit a grainish structure somewhat like wood.

All threaded inserts, plugs or slots should be planned for and installed carefully. Holes may be drilled with a diamond core drill but water under good pressure is almost a necessity. Slots may be ground with diamond wheels or rough work may be done with silicon carbide wheels. Ultrasonic machining works well, especially for odd shapes such as hexagonal holes, splines, etc.

Extremely fine surfaces may be obtained by lapping with silicon carbide and finishing with the finer grades. This can be dirty work, so provisions for "hosing down" should be made if this work is to be attempted. When extra precise ways or reference surfaces are desired, good results can be

*Black granite in this article refers to gabbro types of igneous rock covered in Federal Spec. GGG-463.

Large precision laboratory balance uses a polished black granite base which imparts a decided contrast to the polished brass used throughout the rest of the balance. It was fabricated for $300. A conventional balance would require a $1500 capital expenditure.



Precision granite parallel makes precision way quickly and easily in this sine bar leveling fixture for Taly-Surf instrument.

obtained by using standard laboratory grade surface plates or parallels as a starting point and, if necessary, a final truing with a diamond lap.

Accurate checking methods and equipment, such as autocollimators and reference mirrors are essential for this. Certain interferometers are also applicable to this sort of alignment checking. Threaded or plain inserts are rough finished approximately two to five thousandths smaller than the cored hole and cemented in place with epoxy or a mixture of glycerin and litharge. Very accurate locations can be made from plain, soft steel inserts which can be readily machined. To improve appearance of some instruments, the granites can be polished to a brilliant finish. This however, destroys the accuracy to a degree, so such polishing should be confined to noncritical surfaces.

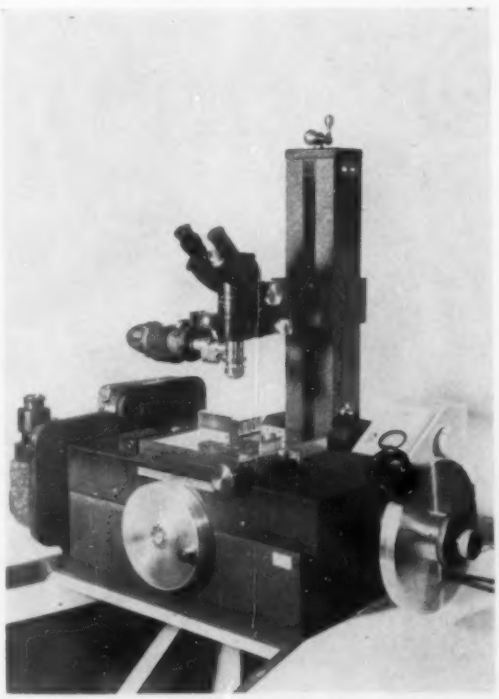
Large special tooling of a high caliber can often be fabricated from granite. Angle plates for specialized, super accurate inspection operations may be assembled, made from standard surface plates. After alignment with an autocollimator and optical square, these are doweled together and cemented. Irregular shapes are relatively easy to set up and may be fastened permanently together if so desired. Such a setup is amazingly free of vibrations and, of course, is very stable.

When designing special test equipment or tooling, cost is always an important feature and several factors must be taken into account; i.e., design time, material costs, manufacturing assembly labor. In addition, consideration must be given to the operation of the equipment. Will it do the job for which it was intended? Will the operators like it and take pride in its upkeep?

With careful planning, the black granites can replace more conventional materials successfully in a number of respects. A comparison of costs involving the finishing of large cast iron surface plates plus upkeep is a good example of this. Intangible benefits such as inherent stability, operator satisfaction with "mass" and appearance, and special designs are also valuable and must not be overlooked.

There are a few disadvantages to granite tooling which should also be considered. Careful planning, however, will overcome most of them. The most common of these is the frequent comparison to steel. It weighs approximately 190 lb per cu ft versus 490 for steel. Another is the difference in the coefficient of expansion; 3 to 4 millionths per inch per degree Fahr. versus 6 millionths for iron or steel. When granite is used for ways or slides it must be carefully protected from oil or moisture as it will only perform properly when scrupulously clean and dry. The necessity for designing it right the first time should be mentioned because this material does not lend itself well to extensive changes.

The accompanying photographs illustrate a few applications of granite tooling and should give ideas for many more. Plans are already under way for a missile nose checker and a large coordinate cathetometer as well as for various toolmaker's microscopes and accessories.



Coordinate measuring machine utilizing a high-power microscope and a built-in autocollimator. The need for extreme straightness of table movement has been filled by using a black granite base and laboratory grade granite parallels for table ways. The installation of parts is made relatively simple by threaded inserts and counterbored holes.

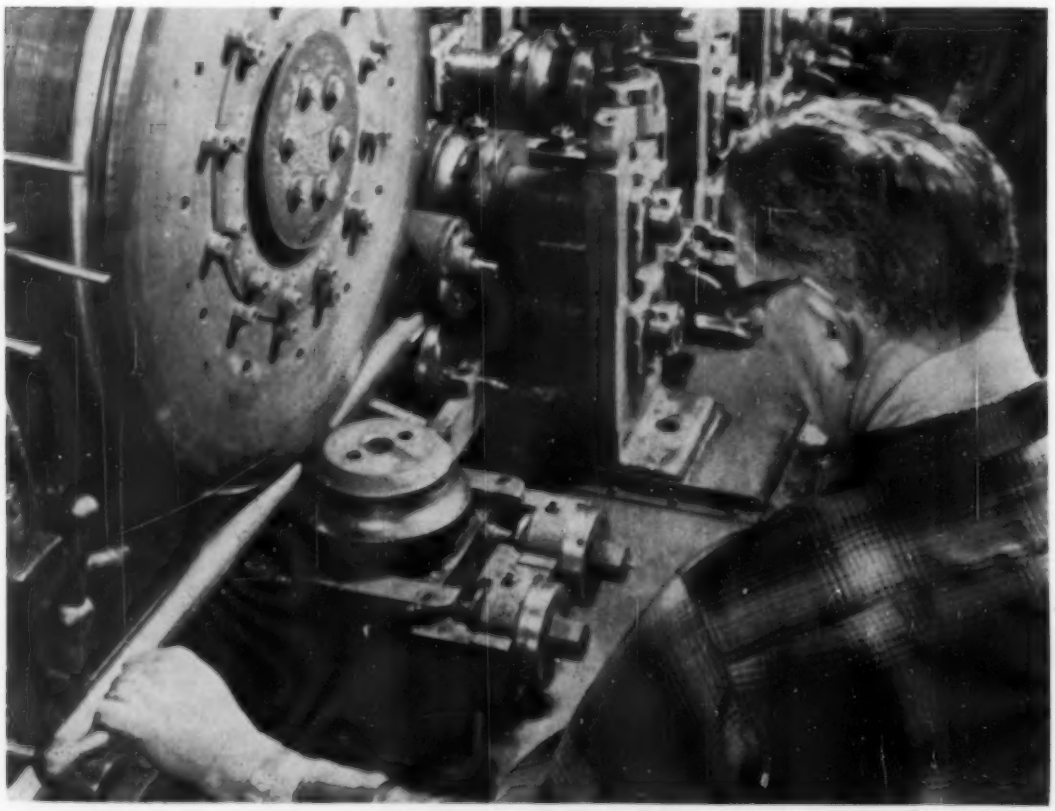
designed for

PRODUCTION

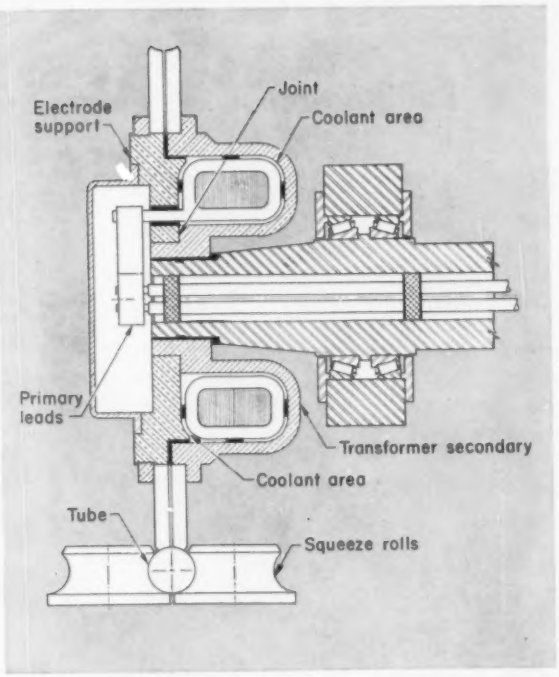
Core Design Increases Welder Efficiency

Welding speeds are dependent on amperage delivered to the workpiece and any increase in amperage results in a disproportionately large increase in speed. For example, a ten percent increase in current results in a 21 percent increase in weld speed. Taking advantage of this fact, Yoder Co. has completely redesigned its tube welder to increase welded pipe production by as much as 60 percent. Primary current introduced to the welding machine remains the same, however.

Increases in current have been obtained by reduction of impedance in the secondary circuit. The secondary circuit consists of the transformer secondary, the welding electrodes and the workpiece. Most of the reduction has been obtained as a result of a new transformer design. In the new design the core is a continuous strip of iron wound into a roll. The primary is wrapped on the core and the entire



SHEET STEEL advancing through forming rolls is seam welded into automotive tailpipe stock. Large vertical wheel is actually two electrodes. Smaller horizontal wheel is one of two that position the workpiece.



SECTIONAL VIEW of the tube welder. Design enables shaft to take full force of welding operation, eliminating any possible thrust on toroidal type transformer from workpiece contact.

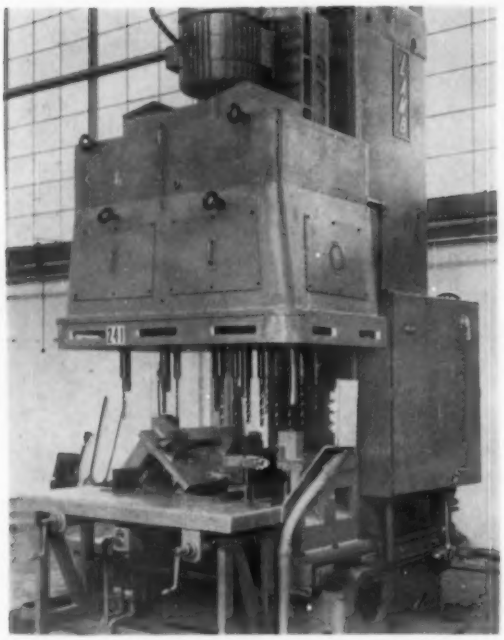
assembly is impregnated with epoxy resin. Insulation rings are then placed on the front, back and OD of the assembly. After the epoxy has cured, the rings are machined and fitted to the cavity in the secondary. This eliminates current losses at joints between the stacked stampings which are normally used as transformer cores. It also precludes any possible loss of current caused by movement between the core and the primary and permits reductions in rotor size.

Indexing Unit Machines From Both Sides of the Work

Machining operations on both sides of the workpiece are performed in this rotary indexing machine, a development of Snyder Corp., Detroit. Designed to drill, ream and countersink automotive door hinges, the machine has six stations which produce a completed pair of hinges with each index of the table.

Countersinking of holes on the underside of the hinges is accomplished with a two-spindle drilling unit mounted under the table. As the hinges index to this station, the countersinking tools ascend through bushings on which the parts are located and complete the operation.

Building-Block Drilling Machine Handles Many Jobs

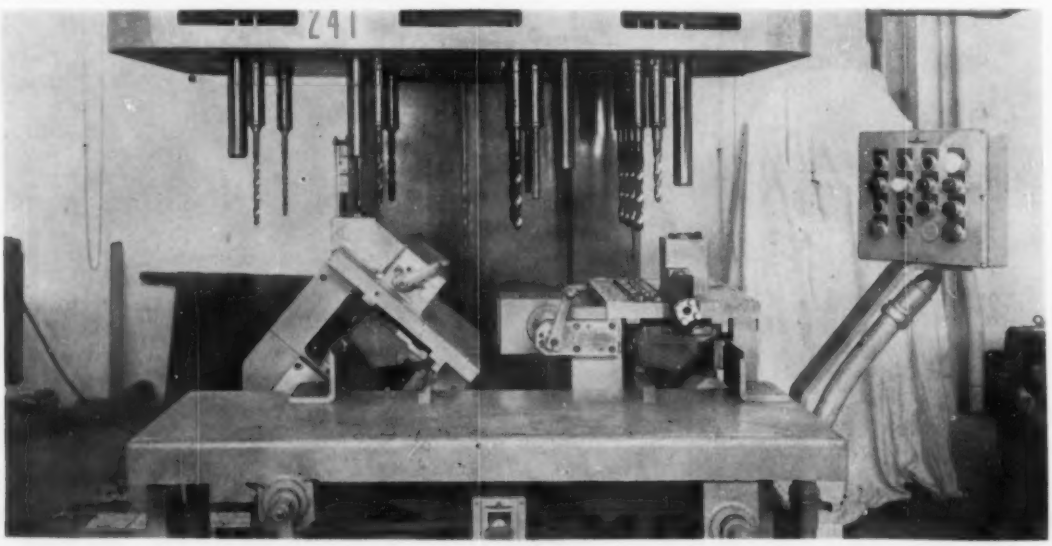


Drilling machine at completion of its test run. Conversion to other jobs involves changing fixtures on table and making a new drill plate.

Flexibility for job change-over and high efficiency even in comparatively small runs are required of today's machine tools. These qualities are demonstrated in this shuttle type drilling machine designed and built by the F. Jos. Lamb Co. The machine drills vertical and angular holes in truck engine heads, finishing 25 units per hour. All components of the machine are standard building-block units and the machine itself is one component in a segmented production line.

Drilling of both vertical and angular holes is accomplished through the use of two fixtures—one to hold the workpiece in the horizontal plane and the other to support it at an angle. Loading and clamping is done manually. After the part is loaded in the first station, the machine head descends and a guide pin engages a bushing in the first fixture to insure correct alignment. After drilling the first set of holes, the head retracts and the table indexes to the second station. In this station drilling of all vertical holes is completed after which the table returns to start position. The workpiece is then unloaded and manually transferred to the second fixture for angular drilling, and the first fixture is reloaded with a fresh workpiece. In this way, two sets of holes are drilled at each cycle of the head and a completely drilled part is produced at each cycle of the table.

Tooling area of the machine. Pins on head maintain fixture alignment. Handles on fixture provide clamping pressure required to secure workpiece.



CHEMICAL MILLING TODAY

By C. H. Rose
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With the development of advanced chemical milling techniques, the process can now be used to produce complex shapes in a wide variety of materials. Accuracy is excellent and fine finishes can be obtained. Costs are often substantially lower than for conventional metalcutting operations and it is possible to perform metal-removal operations that are impossible with other methods.

CHEMICAL MILLING is the precision contouring of metal into any size, shape or form by a controlled chemical reaction. It can save time and money in production and it permits the employment of entirely new design concepts as well.

Metal-removal by either chemical or electrochemical action is not new; however, applying such a process to produce highly complex shapes, nonsymmetrical patterns, intricately stiffened structures and tapered skins is distinctly an innovation in modern manufacturing.

The Process: In chemical milling, parts are precleaned and areas that are not to be chemically milled are masked. The parts are then etched and rinsed, maskant is stripped off and the parts are again cleaned. The equipment required is of the conventional cleaning and pickling type. A typical process flow sheet appears as *Fig.* 1.

There are various means of obtaining selective etching by masking. In one method, protection is obtained by first covering the entire surface of the part with chemically resistant organic coatings that adhere to the surface. These can be sprayed, dipped or brushed on. A template is then applied to the area to be etched and the maskant is scribed through and removed before etching. Stiffeners hold thin sections of the template from moving while the maskant is being scribed, thus maintaining the required close tolerances.

When complex patterns or configurations involving extremely fine detail are required, the silk-screen method of applying maskant is used. The maskant is applied through the screen, which is porous. On areas where no maskant is required (areas to be etched) the screen is covered with a nonporous material that prevents penetration of the maskant.

When masking materials are used, the depth of cut is limited, in most instances, to 0.5 inch. This limitation arises from the fact that gas is trapped underneath the mask. The chemically milled surface will be uneven if the gas cannot be displaced by agitation of the solution. Sometimes it is possible to overcome this limitation by mechanical movement of the parts.

Etching is uniform at any point of the unmasked area and the radius at the edge equals the depth of the etch, as shown in *Fig.* 2. A variety of etchants is in use. With suitable etchants, it is possible to chemically mill a wide range of materials. Aluminum, magnesium, steel and titanium alloys are commonly etched on a production basis. A partial list of the alloys that have been successfully chemically milled follows:

Aluminum: 1100, 2014, 2024, 5052, 6061, 7075, 7079, 7178, DTM 646
Magnesium: AZ31B (FS-1), AZ63, AZ91A, EZ33, HK31, HM21, ZK51, ZK60A
Titanium: A-70, A110AT, C-110M, C-130AM
Steel: 17-4, 17-7, A286, 304, 316, 321, 347, AM 350, 4130, 4340, Hi-Tuf, Inconel X, Inconel, Inconel 702, Monel, K Monel, Incoloy (annealed) HH, Nimonic 75 (annealed), Nickel (annealed)

Quality Control: Quality in chemical milling is achieved by precisely controlling the strength of the etch bath, temperature and time of immersion. On identical materials, uniform conditions will produce uniform results. Variations in the finished thickness of a part will then be dependent on the variation in original thickness of the raw stock. If

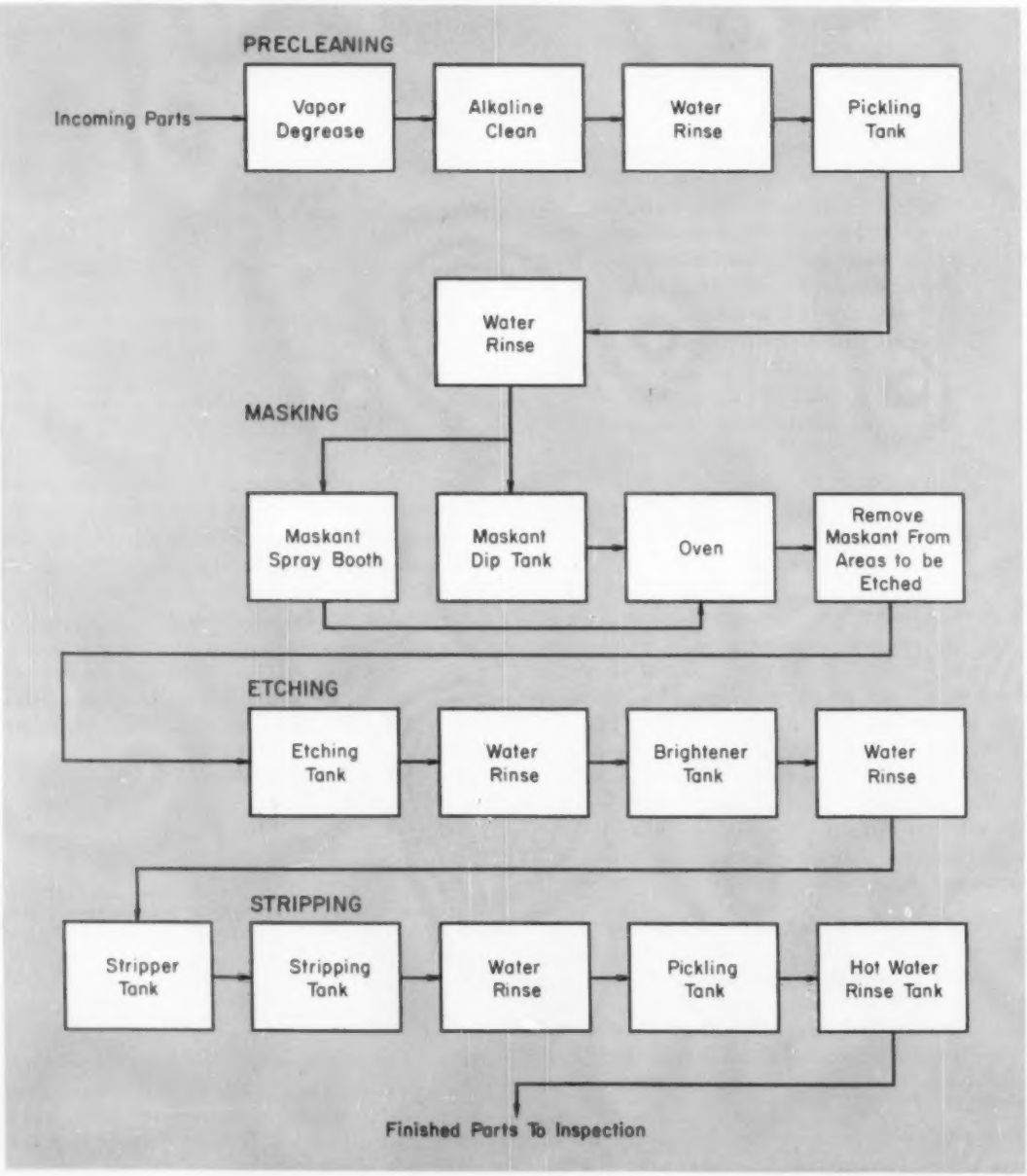
that thickness is excessive, the finished dimensions will also be excessive.

Depth tolerances can be stated only in relationship to the tolerance of the original material. Tolerances of ±0.003 inch can be held on cuts of 0.125 inch or smaller depth. On deeper cuts, tolerances are in the ±0.005-inch range. Under special conditions, tolerances of ±0.000 inch have been held. Line definitions of ± 1/32 inch are readily obtained.

The condition of a surface before chemical milling affects the condition of the finished surface. In the early stages of the development of chemical milling, the original surfaces could not be improved. Today, however, with the newer etchants, the process improves the surface finish of a great number of alloys. The amount of improvement depends on the properties of the alloy.

On alumium alloys, surface finishes of 125 microinches, rms, are obtained on good stock. When the original surface is poor, finishes no rougher than 250 microinches can be obtained. With magnesium alloys, surface imperfections can be "washed out"

Fig. 1. Chemical milling process flow sheet for parts that require masking. Parts that do not require masking bypass masking and stripping areas.



to a great extent. Eighty-microinch finishes are possible. Mirror-like finishes in the 40-microinch range can be obtained on titanium alloys. Grooves and surface ridges tend to wash out. On steel, excellent surface finishes are produced on cuts of ¼-inch or smaller depth. A 60-microinch finish can be chemically milled on 4130 steel, for example. For deeper cuts, the finish depends on the granular structure of the alloy.

The physical and mechanical properties of chemically milled parts such as sheets are practically the same as those of sanded and polished machine-milled sheets. Careful microscopic examination of chemically milled parts shows that there is no chemical attack between grain boundaries of the surface and no change in composition of the surface. No deleterious effects of chemical milling on fatigue strength have been noted. The possibility of stress corrosion effects in parts containing appreciable residual stresses must be considered, however.

Applications: Cost comparisons between chemical milling and machine milling often show considerable savings for chemical milling. Such cost comparisons are difficult to evaluate because they are calculated for etched parts that could be duplicated by machine milling. Many parts can be made only by chemical milling and for these no cost comparison can be made.

Chemical milling has advantages that are not readily evaluated in dollars and cents, such as simplified and lighter-weight construction and improved quality of product.

The most economical chemical milling operations are those where no masking is required. For example, some forgings, extrusions and drawn parts that require thick sections for ease of fabrication can be reduced in weight simply by etching.

Forgings having large web areas in the forging plane that cannot be forged to minimum design thickness can be readily etched to the desired dimension. The amount of metal to be etched must be added to the over-all forging dimension to eliminate masking. A cost evaluation should be made for both methods—no masking versus partial masking—before a decision is made.

Many extrusions are heavier than necessary because of limitations in extruding thin sections. The thickness of these sections can be reduced simply by immersion in the etching solution for the required time or, if desired, they can be tapered.

Drawn parts are more easily fabricated from heavy material that is subsequently etched to the desired thickness. Etching proceeds uniformly in all directions and at the same rate in both stressed and unstressed areas; therefore, portions thinned due to drawing should be given consideration during part design.

Tubing that is to be fusion welded to an end fitting or another tube can be etched outside or inside except for a short distance from the end to be welded, where material is left to compensate for the weld factor.

Full advantage of weight reduction can be taken on panels that have varying stress patterns. Web areas with four or more different thicknesses are practical to produce by chemical milling, using a step-masking technique.

Castings: Castings are a new field of application for chemical milling. The results have been as successful as for sheets, extrusions and forgings, making it possible to produce better designed castings than have been previously available.

Ideally, structural requirements should be used to determine section thicknesses when designing castings. On the other hand, one of the basic foundry rules is that all sections of a casting should be as nearly uniform in thickness as possible to prevent such common casting defects as hot tears and casting strains. Inner sections of a casting are an exception to this rule. Sometimes they must be made thinner than outer sections to provide proper cooling after metal has been poured into a mold.

Since chemical milling acts on any surface regardless of shape or location, the part designer can accurately calculate the structural requirements of the finished part first, then add the necessary metal to make the casting a sound one. After casting, all excess metal can be removed by chemical milling. Metal-removal can be over-all or restricted to selected areas.

In over-all reduction, the entire part is exposed to chemical solutions; therefore the designer may have to increase certain dimensions on a casting so that every section will have the proper dimensions following chemical milling. In controlled-area chemical milling, certain areas of a casting are covered with a protective coating of maskant. This eliminates the need to cast additional weight into sections that do not require it for ease of casting. Instead, those sections are cast to the correct dimensions.

The surface finishes of castings are generally improved by chemical milling. The surface improvement depends in part on the porosity of the casting and also upon the alloying constituents. For example, finishes on aluminum castings depend on the silica content. The as-cast finish is usually fairly rough. After chemical milling, finishes are usually 250 microinches, rms, or better. Surfaces of steel castings are also improved by chemical milling. Depending on the original surface finish, finishes in the neighborhood of 125 microinches are possible.

In every case, the finishes depend, to a great extent, on the casting process used. Individual part configuration and depths of cut also affect finishes

to a significant extent.

To test the chemical milling of castings, an 810-lb breech ring casting of 4340 steel was processed on an experimental basis. The first step was to lay out the final dimensions of the casting from all centerlines to accurately determine the size of the rough casting. This was necessary to establish the amounts of material to be removed from various

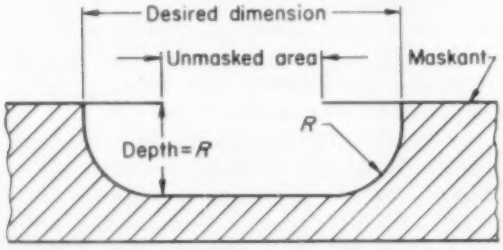


Fig. 2. Cross section showing normal undercut occurring on a masked chemically milled part.

areas. It was determined that an average of 0.250 inch of stock was to be removed from unmasked areas.

Since the stock distribution was not uniform, several areas had to be protected from etchant during part of the chemical milling operation. A special paint type maskant was used. Six coats of this material were applied. Thirty minutes of drying time were allowed between applications. Two layers of a special adhesive lead tape were applied for additional protection during milling—a precaution that may not be needed in all cases.

Prior to milling, the breech ring was weighed so that the total weight removed during milling could be determined. Then the ring was rigged with a stainless steel cable and suspended in a descaling solution for several 10-minute periods to completely remove the scale. It is essential that all scale be removed to insure uniform chemical milling of all areas. The scale could have been removed by sandblasting at considerably lower cost but sandblasting equipment was not available.

For chemical milling, the breech ring was suspended in a stainless steel tank that was ventilated by a blower to remove the toxic fumes that are generated during the process. Although the temperature of the etchant material was specified as 150 F for the operation, etching was initiated at 118 F since heat is generated during the removal of large amounts of metal. The temperature of the etchant rose to 150 F during the second hour of processing. Total chemical milling time was 61 hours, with an average metal-removal rate of 0.0007-inch per minute.

Chemical milling was followed by cleaning. Since some smutting occurs during the removal of large quantities of material and since all evidence of the etchant must be removed, the breech ring was rinsed in clear water after chemical milling, then cleaned in a pickling solution to remove smut, then rinsed again in clear water. A rust preventive solution was applied to protect against corrosion during transit.

The weight of the breech ring at this time was 768 lb, indicating that 42 lb of metal had been removed. The surface finish was 62 microinches. Most external dimensions were within or slightly over drawing specifications. Several were slightly below drawing specifications in some areas, however. This was due to the inability of the chemical milling process to correct out-of-square or out-of-parallel conditions without excessive masking. Nevertheless, the experiment was regarded as a success, since it demonstrated the ability of chemical milling to give satisfactory results when processing large castings.

To sum up the Watervliet findings: chemical milling is a versatile and useful production method. It can replace conventional machining operations in many cases, often with cost-cutting results. Labor requirements are low and chemical milling can easily be automated through electronic timers and other instrumentation. No subsequent sanding or polishing is needed, due to the excellent surface finishes obtained. And, perhaps most important, it can perform operations that cannot be performed economically by any other metal-removal process available to engineers today.

"That's correct, it'll run 24 hours a day by itself and as soon as I find out what it's making I'll put it out on the market."

Fig. 1. A few quick-acting mechanical clamps, a 5/8-inch plate and a few small pieces of mild steel placed to act as stops are the only parts needed to hold assembly in position while welding.

Semiautomatic Welding Simplifies Fixturing

By H. F. Kocher
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Vapor shielding and semiautomatic welding are proving economical for weldments formerly produced exclusively by manual methods of welding.

BY USING SEMIAUTOMATIC WELDING to replace conventional hand welding, no major expenditure for fixturing and positioning equipment has been necessary for the fabricated assembly shown in *Figs.* 1 and 2. On this application, substituting semiautomatic vapor shielded arc welding for manual arc welding, reduced fixturing 50 percent and achieved a 28 percent reduction in welding costs over conventional manual methods. The improved process also offered the possibility of stepping up material flow through the shop, thereby increasing production efficiency of existing plant facilities.

Thirty-one welds required to complete this assembly consist of 5/16-inch fillets and lap welds. Weld length varies from 1 inch to a maximum of 6 inches. Production of these short welds is further complicated by the limited accessibility conditions of some welds and the requirement that direction of welding be changed without stopping on others. Inner shield squirt welding developed by Lincoln Electric Co. of Cleveland, Ohio, was selected for the job. This process employs a tubular, self-shielding electrode. The electrode is fed continuously through a welding gun, manually supported and guided along the joint. The deposition rate usually doubles and sometimes triples manual welding speed. Also, no externally introduced shielding or fluxing material such as gas, granular fluxes, or wire coatings are required.

Vapor shielding is accomplished in the following manner. The fabricated electrode consists of a mild steel tube into which are placed materials for shielding, deoxidizing and fluxing. A portion of these ingredients are metallic salts and oxides. These metallic salts vaporize and expand when introduced into the intense heat of the arc. As they reach the isothermal cone surrounding the arc corresponding to their condensation temperature, they recondense forming a relatively thick vapor shield around the arc and molten metal, preventing con-

tamination from the surrounding atmosphere. Other materials in the electrode provide oxidizing and alloying functions in creating high-grade welds.

Production volume was raised from 17 to 23 units per day, an increase of approximately 30 percent. Increased welding speed was the primary factor responsible for this improvement. Formerly the assembly was welded with a $\frac{5}{32}$ inch AWS E-6024, 50 percent iron powder coated electrode. A machine setting of 250 amp produced an average welding speed on the $\frac{3}{16}$-inch fillet and lap welds of 15 ipm. The new method uses a welder setting of 400 amp, DC (+) at 29 volts increased this speed to 22 ipm.

Introducing mechanized welding reduced fixturing 50 percent. Formerly manufacturing procedures involved two welders and two assembly fixtures. Each welder was responsible for loading and unloading his welding fixture as well as performing the welding operations. The new method still requires two men but only one man is a welder, the other being a helper. Using one assembly fixture and a flat table, the helper loads and unloads the fixture while the welder is completing the welding of the assembly lying on the flat table.

Welding sequence for joining the members of the fixtured part is closely controlled to eliminate any misalignment that could develop from weld shrinkage. The welder places his first weld at the narrow end of the assembly and then alternates from side to side as he progresses toward the wide end.

Fig. 2. Typical welds joining structural parts are produced at a speed of 22 ipm.

Relative position of all welds is such that they can be made in a horizontal position with only one change in assembly position. Tacking has been minimized through efficient part design and the use of mechanical clamps.

Test Determines Corrosion Resistance

Measuring the corrosion resistance of anodized aluminum parts is rapid and practical with a new electrochemical procedure. Called "Fact," the testing process was developed primarily for checking exterior auto parts such as grilles, moldings and headlamp housings.

The test, devised by manufacturing development engineers of the Ford Motor Co. manufacturing staff, consists of placing a small electrolytic cell containing a corrosive agent in contact with the surface of the part. The subsequent resistance to a mild electrical current is measured during a 3-min period in which the corrosion of the coating is accelerated and the insulating effectiveness of the coating is determined. A poorly protected part gives a reading of 600 to 650, while a satisfactorily protected part registers 750 or above.

The test has been correlated closely with results of more than 2000 samples which were exposed during winter field tests. Ford has since presented the test to the aluminum industry as a means of controlling its production processes and as a research tool for obtaining a more complete understanding of the factors affecting the corrosion of anodized aluminum.

The procedure can be used on all production parts and, because it provides results in minutes rather than hours or days, it can be readily applied to mass-production processes. Shown here is an inspector conducting the test to determine whether the aluminum used in a tail light has been processed in its manufacture so as to provide maximum resistance to corrosion.

numerical control in JAPAN

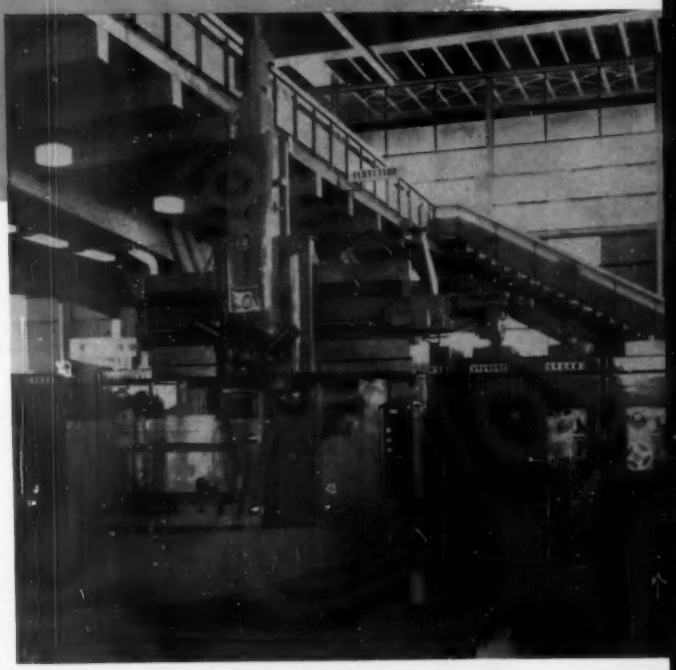


Fig. 1. All operations of this Japanese-made vertical turret lathe are performed under numerical control.

Although America still retains world leadership in the numerical control field, other nations, including Japan, have rapidly developed numerical control techniques and equipment. This article is based on a survey of Japanese numerical control systems made by Keiji Okushima and Katsundo Hitomi, both professors in Department of Precision Engineering, Kyoto University.

NUMERICAL CONTROL has received its greatest impetus in the United States, where labor costs are high and there is a demand for fast, automatic machine operation. Countries with lower costs have been following numerical control developments closely, however, and they have started to build numerically controlled machine tools for their own needs. Japanese industry, for example, has developed a number of successful positioning and contouring controls. These controls, *Fig.* 1, are not mere imitations of foreign models—they are Japanese-engineered.

Many are equipped with "parametrons"—a Japanese-invented device that replaces electronic tubes and transistors. Parametrons are virtually unaffected by temperature—important when controls are used in shop environments—and their life is so long that they can almost be regarded as permanent parts of the control. Their response is slower than that of electronic tubes and transistors, but fast rate of response is not as important in machine tools as it is in digital computers and other high-speed applications where extremely high numbers of relay operations are involved for each cycle.

Numerical control developments in Japan have been sponsored by the government as well as by industry. The first Japanese positioning control equipment was made in 1955 at the Government Mechanical Laboratory. This was an experimental model. The first practical Japanese application of numerical control was made in 1956, when a numerically controlled turret punch press was put into production operation.

In 1957, the Precision Engineering Laboratory of the Tokyo Institute of Technology completed a numerically controlled lathe, using a control method similar to that developed in the United States at the Massachusetts Institute of Technology. A Japanese-made tape-controlled milling machine was introduced at the Japan International Trade Fair in 1958. The Government Mechanical Laboratory had a tape-controlled jig borer in operation in 1959.

Japan, then, is not a Johnny-come-lately in the field of numerical control. Efforts to develop nu-

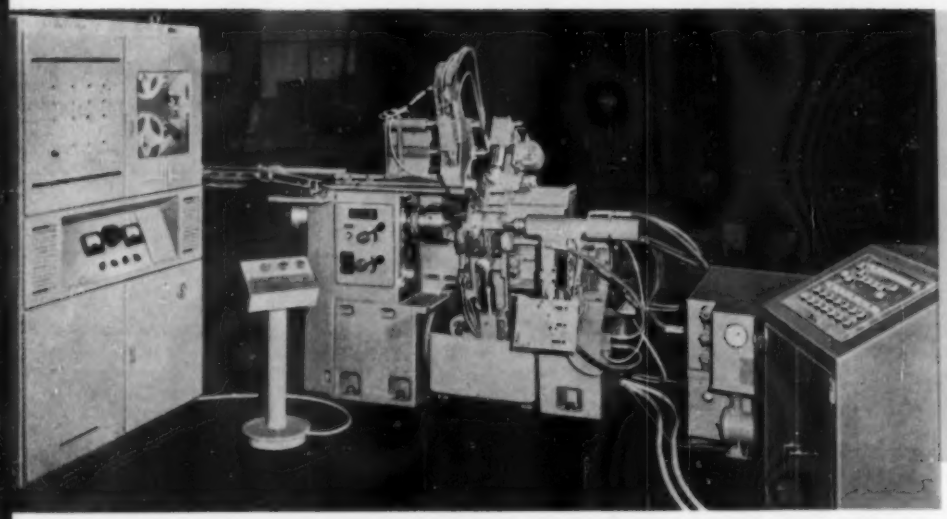
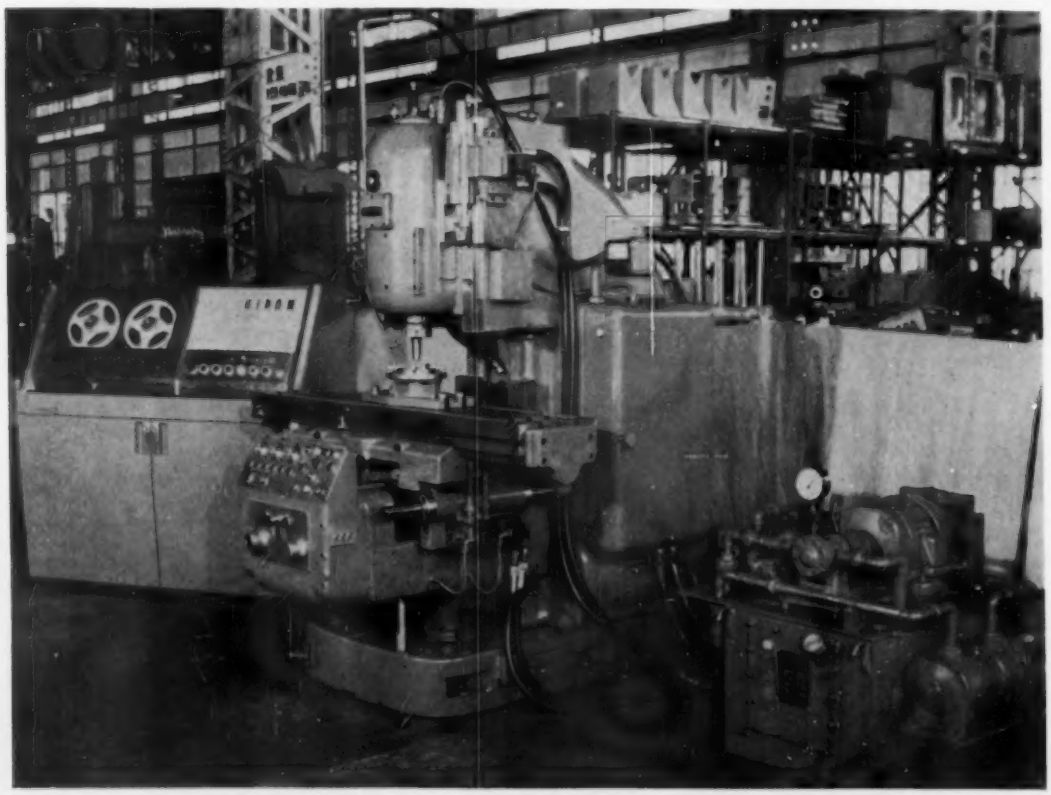


Fig. 2. Tape controls contouring, facing and cutoff operations in this Japanese automatic lathe.

merically controlled equipment have been—and are —well supported by government and industry. While there are still relatively few applications of numerical control in Japan, there is ample evidence that the Japanese controls are of a high level of technical sophistication and that Japan could become one of the leaders in this field.

Positioning Controls: Japanese positioning controls are capable of high accuracy and are comparable to American models. In one positioning control for drilling and boring, machine instructions are coded in punched-tape form. The tape controls positioning and machining operations, and stops the machine for tool change when a predeter-

Fig. 3. Japanese machine for three-dimensional milling uses a magnetic tape.



mined number of cycles has been run. Positioning accuracy is within 0.01 mm and machining accuracy is within 0.03 mm. If the positioning error exceeds 0.01 mm or if the bed reaches its limit of movement, a warning signal is made so that the machine operator can make any needed adjustments. Parametrons are used in this control.

A numerically controlled jig boring machine developed at the Government Mechanical Laboratory is unusual in that it is controlled by two tapes—one for positioning the machine table and the other for controlling machining operations. Data from both tapes are handled by the control, which contains 3500 parametrons, 100 relays and 50 electronic tubes. The system has both coarse and fine driving scales.

Continuous-Path Controls: Numerical controls have been applied to both lathes and milling machines in Japan. Tracer and numerical controls are combined in one lathe. Contouring is performed under tracer control and variables such as the length to be machined, cutting speeds, rates of feed and so on are programmed on punched cards. Changes from one machining operation to another are also programmed on the punched cards.

The automatic lathe shown in *Fig* 2 is controlled by magnetic tape. Both the upper and lower toolposts move under tape control. The upper toolpost moves in both longitudinal and radial directions, since it is used in contouring, while the lower toolpost, which is involved in facing and cutoff operations, moves in the radial direction only. Stock is automatically fed into position for machining, clamped and released by means of a system of microswitches and relays, making machining fully automatic.

The Japanese vertical turret lathe shown in *Fig*. 1 is controlled by magnetic tape. Both contouring operations and machine turret indexes are automatic. Thus a series of operations can be performed without operator intervention. Movement of the toolpost is controlled through phase modulation of an a-c signal of constant frequency. Other operations, such as the start and stop of the table, turret indexing and so on, are controlled through frequency modulation. A seven-channel tape is used.

The machine shown in *Fig*. 3 performs three-dimensional milling operations. It is magnetic-tape controlled. Machining instructions are recorded on the tape as analog quantities by the digital phase modulation method. A small digital computer prepares the machining tape. A new model of this machine incorporates an automatic tool changer. Machining accuracy is within 0.05 mm for profile milling. Positioning accuracy is within 0.03 mm.

The examples cited make it clear that Japanese numerical control is thoroughly up to date. Other than the application of the parametron, no important differences between numerical control developments in Japan and those in other countries are apparent. Nevertheless, Japanese capabilities in the numerical control field are already well established. Technological progress knows no national barriers and Japanese industry is already well on the road to automation of manufacturing operations.

Safety Program Checks Potential Accidents

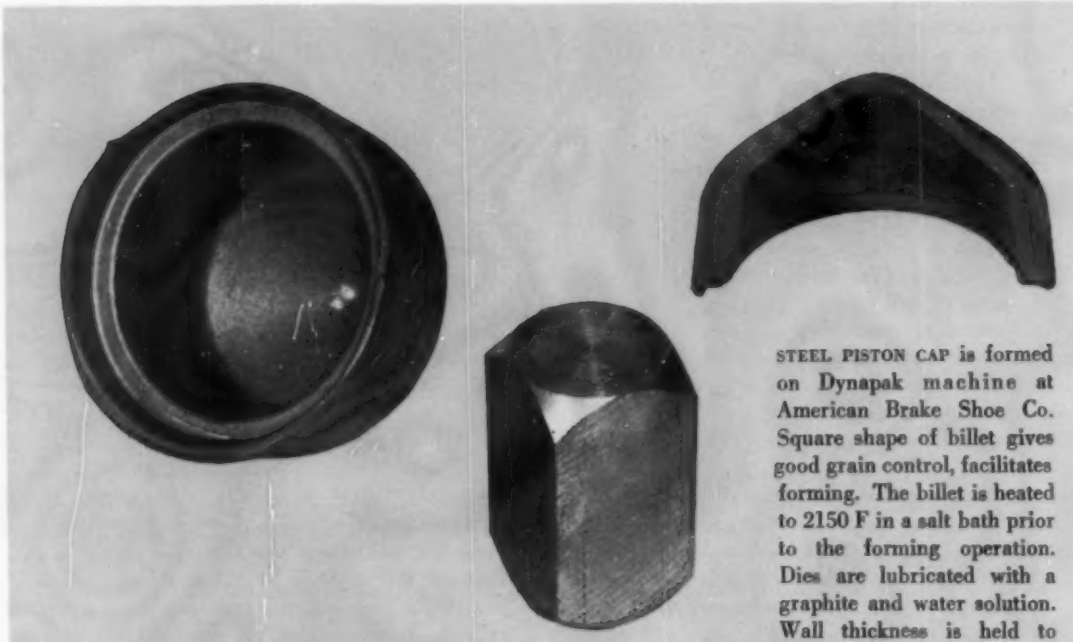
Encouragement, cooperation and follow-up are the strongest planks in a safety platform which is responsible, to a large degree, for the excellent safety record held by the Timken Roller Bearing Co. of Canton, Ohio.

Under the program, a group of production, maintenance and safety supervisors, led by the superintendent of the maintenance department, meets every other week. After the meeting, the members are separated into six two-man inspection teams. They then visit the department selected for inspection and note safety hazards and unsafe practices. At the conclusion of the tour, each member of the team submits his notes taken during the tour to the secretary of the group.

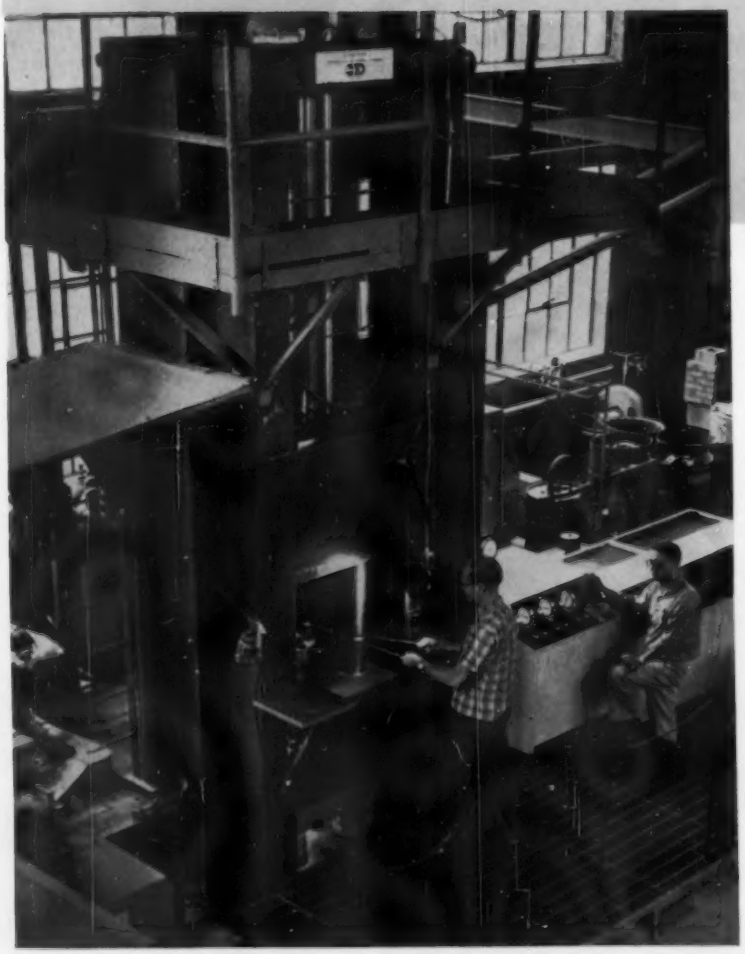
Two weeks after the tour, the group meets with the general foreman of the department to discuss the safety problems observed. Item by item is dealt with in the order established by the members of the group. Remedial action to be taken by the group is planned at this time.

Five days later, the group members, the general foreman concerned and the top members of operating management receive copies of the report. The general foreman and members of the group then have approximately a week and a half to correct any unsafe conditions that were noted by the teams. To each safety problem on the agenda is attached a note describing the action taken. As long as a problem has not been remedied to the group's satisfaction, that item stays on the agenda.

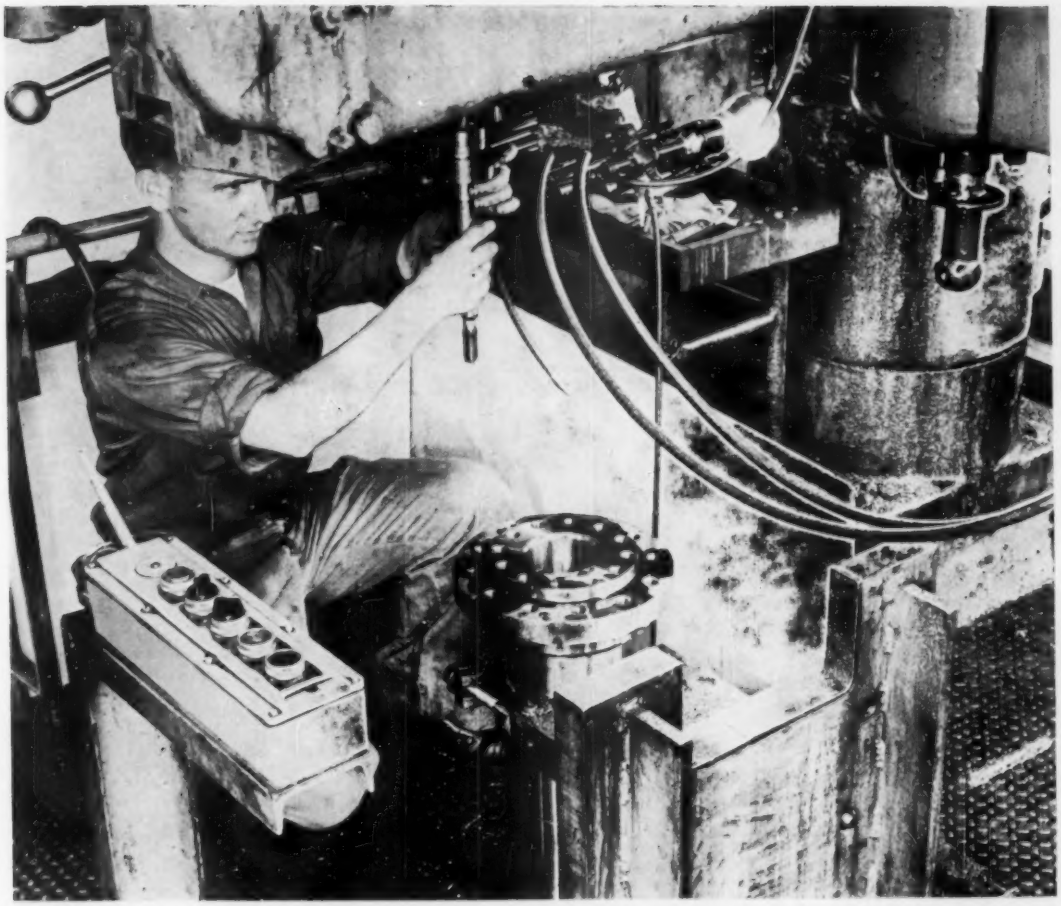
Although Timken's safety record has been excellent for many years, this safety program has made further improvements. Because it enlists voluntary and enthusiastic support of supervisors and employees and assures prompt and efficient follow-up, the program is an invaluable asset in reducing the accident rate by reducing the accident potential.



STEEL PISTON CAP is formed on Dynapak machine at American Brake Shoe Co. Square shape of billet gives good grain control, facilitates forming. The billet is heated to 2150 F in a salt bath prior to the forming operation. Dies are lubricated with a graphite and water solution. Wall thickness is held to 0.180 inch, ±0.005 inch. Concentricity is ±0.010 inch. At least four press strokes would be required to form this part by conventional methods.

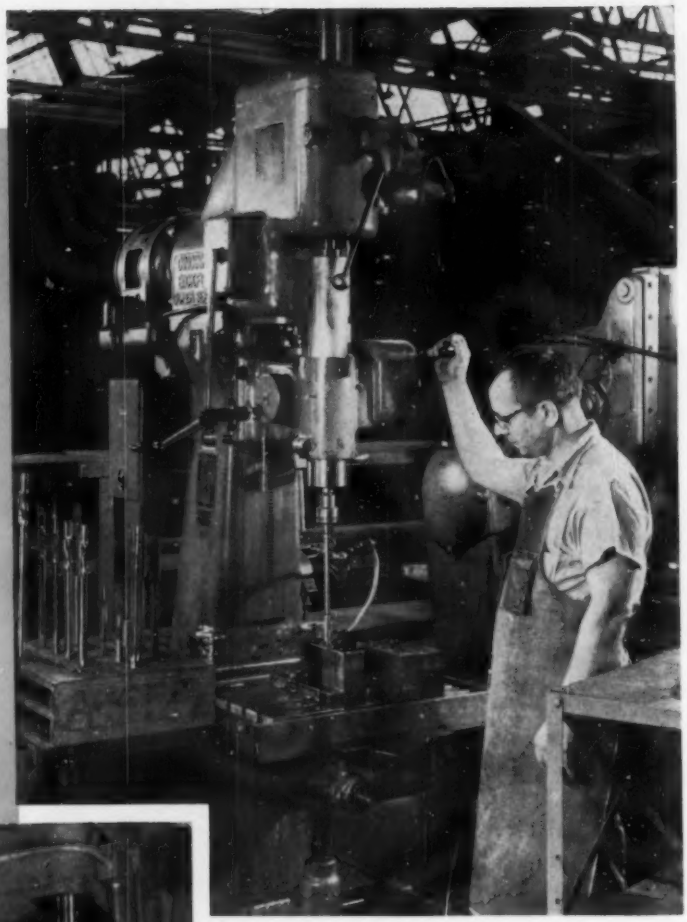


INTRICATE PARTS of 4130 steel, tough pitch copper and copper powders are formed in one hit on this Dynapak machine at American Brake Shoe's Mahwah, N. J., research center. Ram velocity ranges from 250 to 1500 inches per second—one hundred times faster than conventional high-speed extrusion presses. At this speed high, abrupt pressures are created, causing severe deformations. Metal moves faster and farther than when formed conventionally. Cycle time is 110 seconds.

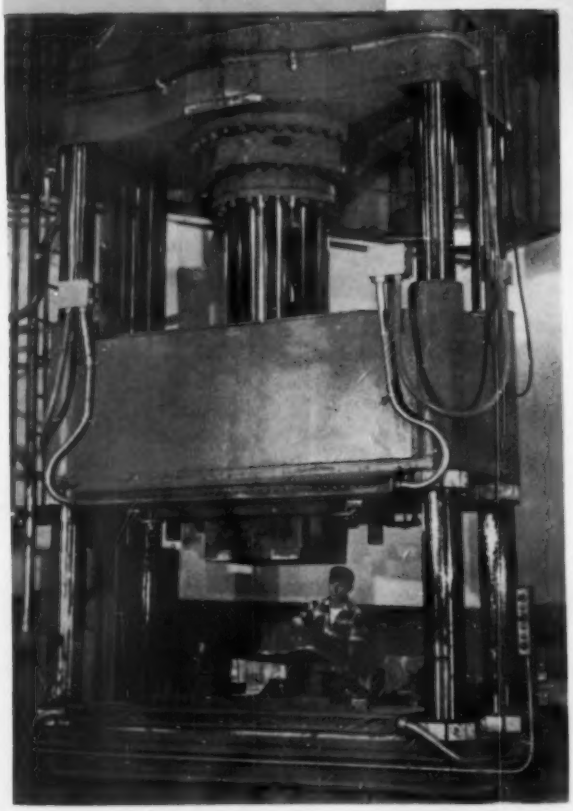


TURRET LATHE SPINDLE is drilled and tapped in a special trunnion fixture at Warner & Swasey's Cleveland plant. The trunnion fixture, which can handle different-size spindles, is powered electrically and can index 90 deg or 180 deg, depending on the specific requirements of the workpiece being machined. Operations are performed on a radial drill. Because of the length of some workpieces, the fixture is recessed into the floor. This makes loading, indexing easier.

TOOLS at work



HOLE ROUNDNESS and size tolerances of 0.0005 inch are met and surface finishes of 25 microinches are obtained by reaming at The Warner & Swasey Cleveland plant. The holes in the valve bodies shown accommodate sliding valve spools, so high finishes and accuracy are mandatory. Workpiece material is No. 40 cast iron. Speed is 489 rpm; feed is 0.0045 ipr. The reamer has carbide flutes. Previously, the holes were reamed with high-speed steel tools, then honed in a separate operation. The carbide reamer produces finished holes in one operation.



TOOLS at work

EXTRA-HIGH temperatures necessary for molding newly developed compounds in the epoxy, silicon, phenolic and cermet material families are provided by electrically heated platens in this 1000-ton hydraulic press at Lockheed's California Div. factory in Burbank. With an 8-foot stroke and 8 feet of air between the platens, the machine forms flat plastic slabs, sometimes built up from 100 to 200 layers of material, without dies. The plastic slabs are then sawed or machined into aircraft and missile parts. Platen temperatures to 1000 F are used.

Precision Hole Boring
...with portable tools

By Richard Mase
Project Tool Engineer
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Novel and versatile portable tooling, developed for boring armament holes in the wings of Tiger supersonic fighters, performs highly precise operations in an easy and economical manner.

CONFRONTED with the problem of boring accurate large diameter holes in the wings of the Grumman "Tiger" supersonic fighter, Grumman tooling engineers found a practical solution by combining the versatility of a Keller Airfeedrill with the rigid structure of an airframe assembly jig. In this way they were able to develop a novel and inexpensive tool, *Fig.* 1, that performs better than more elaborate setups.

As simplification is the keynote of the Tiger design, the entire top and bottom sections of the wings are machined from single sheets of aluminum. This design, while enabling the wings to serve as integral fuel tanks, created knotty problems for the armament engineer. These were eventually resolved into a configuration which dictated that large diameter holes be bored and counterbored through the wing. Tolerances specified for these holes are critical and are ± 0.001 inch on the hole diameter and ± 0.003 inch on the hole concentricity.

The holes, each in turn, receive two partially machined plug fittings which are externally threaded at one end. These pylon fittings, as they are called, are then installed in a spacer fitting located between the upper and lower wing panels. Once in place, the pylon fittings, *Fig.* 2, are also bored and counterbored to the same close tolerances. This design, when accurately jigged and machined, gives the engineer an arrangement whereby armament and external stores of varying configuration may be hung from the undersurfaces of the airplane wings. Also, this arrangement does not compromise the integrity of the wings in their functioning as a leakproof fuel cell.

Different methods as to how manufacturing should approach this problem were discussed. In general, all indications pointed to some type of machine shop setup incorporating the use of a radial arm drill or boring mill; a machine possibly requiring a special modification so that the job would be done properly.

With this approach it appeared that complex fixtures with indexing and turnover facilities would be required. Accurate holding and positioning features were also an essential requirement for these fixtures since basic geometry dictated that other wing points be held to within ± 0.005 inch relative to the pylon poles.

It became apparent that the most efficient type of boring mill or radial arm drill fixture would be the wing assembly jig for the Tiger or a similar type of tooling structure. However, the reaction to jacking a structure of this size under or into a machine tool was a negative one. Almost intuitively, it was recognized by manufacturing that a setup

Fig. 1. Roughing out a 3¼-inch hole in the upper wing skin using a special hole-saw cutter.

such as this would be costly. Secondly, to provide the proper support for the operation, the additional costs of handling, transportation, scheduling, plant layout, etc. would almost without exception be excessive.

On the other hand, a setup that was desirable to manufacturing and production was one that would have the assembly jig remain in the assembly department and one that would have the machine tool brought to the jig. The setup would be even more desirable if this machine tool possessed such attractive features as:

1. Ease of handling
2. Reasonable weight
3. Adaptability to accurate setup
4. Minimum maintenance and service downtime

This concept of features virtually eliminated the boring mill type of machine tool as a logical choice.

Following extensive tests under simulated conditions, the Keller Airfeedrill proved superior. This tool successfully fulfilled all the initial requirements established by manufacturing. Also, in its favor was the fact that it was standard equipment in the production shop.

The Airfeedrill picked to do the job has 2½-inch variable-feed travel with an operating speed of 175 rpm. Although it is rated to drill a maximum hole of ¾-inch diameter in mild steel, it actually is capable of boring a 3.875-inch-diameter hole through a ½-inch piece of 7075 T6 aluminum alloy.

With testing completed and the portable machine tool selected, the concept of the air frame assembly jig and the Keller Airfeedrill as a combination tool began to shape up as a reality. Tool designers and toolmakers combined their talents to produce a required group of special cutting tools for the job.

Micro-Bore adjustable tool bits, *Fig.* 3, were adapted to the boring bars and were used in both roughing and finishing operations. Chatter-free finishes of 10 to 20 microinch, rms on the holes were obtained by these single-point tool bits.

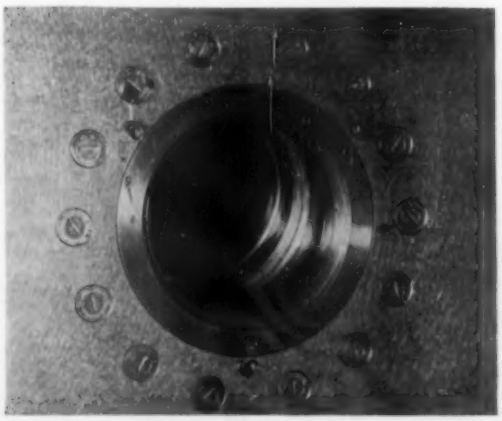

Fig. 2. Finished installation showing upper and lower pylon fittings in place.

Well designed and sturdy pilots on the boring bars and the use of a "sulfalube" cutting compound during the boring operations were also essential to achieving fine, smooth finish. The hole-saw cutters, mounted on special bars, incorporate design features such as extra-deep throat radii and cutting teeth with opposite end cutting angles. The throat radii provide additional area for chip removal from the relatively deep cut; whereas the opposite end cutting angles on the teeth serve as efficient chip breakers. The material, from which the cutters are machined and ground, is high-speed steel (Star Zenith), oil hardened.

A predominant aspect of this tooling is the savings, in time and dollars, that are being achieved while meeting wing delivery schedules. Once the learning phase had been completed and the preliminary bugs worked out, production personnel were able to bore four wing panels during the usual eight-hour shift. This performance exceeded all expectations and reflected an increase of almost 300 percent over the estimates projected for the "boring mill-machine shop" type of operation that had been originally contemplated.

In addition, there are other advantages that represent cost savings to both the tooling and production departments. For the tooling people:

1. Design and manufacture of expensive and complex machine tool fixtures was not required
2. Design and manufacture of special handling and transportation equipment was not required
3. Design and manufacture of a large machine tool was avoided.

Because of these three items, the lead time required by tooling to do the job was reduced. There was, therefore, a corresponding reduction in the need for tooling overtime or additional manpower to complete the work.

For the production people it meant that:

1. Costly modification of a machine tool or an expensive purchase of a special machine was eliminated
2. Labor costs were reduced due to the utilization of less skilled assembly personnel to set up and perform the boring operations
3. By keeping the wing on the assembly floor, within the production flow of work, the costs of supporting functions, such as production planning, control, scheduling and plant layout, were kept to a minimum.

This method of boring large-diameter holes with a light, portable tool has been in operation for over 400 wings. It has been consistent in meeting a tight schedule while maintaining the high standards of quality that the engineering design dictated. So successful and reliable has been its application, from all viewpoints, that it is currently being used on the wings of Grumman's newest aircraft, the Intruder.

ENGINEERED PRODUCTION of carbide dies

By Daniel B. Dallas
Associate Editor

When Oberg opened its doors for business in 1948, its capitalization was $50,000, its employees numbered three and its base of operations was a rented garage. Today the company is producing $2,000,000 worth of carbide dies annually. The reasons for its success are intensive specialization, first-class machine tools and a new concept of what a die shop ought to be.

CARBIDE DIES have always represented the ultimate challenge in die design and fabrication. In most cases the challenge is studiously ignored by most shops for two reasons: carbide is the most difficult-to-machine die material in existence and dies constructed of carbide are almost invariably designed to tolerances impossible to attain in conventional shops. One company that has taken up the challenge is Oberg Mfg. Co. of Freeport, Pa. This company has refined the techniques of carbide die manufacture to the point where it can now build and deliver some types of carbide lamination dies in the heretofore impossible lead time of ten working days. If a customer is willing to pay for the overtime incidental to a crash program, a die can be completed in as little as four days. These dies are not built with conventional fabrication methods nor by typical die shop personnel. The

Fig. 1. Laboratory inspection of incoming carbide sections. After inspection these are classified by size and stored for future use.

company has no employees who fit the definition of "tool and diemaker" in the accepted sense, and virtually all employees are company-trained.

Personnel: Most employees are trained in one of the company's two principal divisions—the grinding department and the toolroom. New employees become apprentices in either division. The apprentice program lasts four years and it consists of in-shop training and attendance in the company training school. Because of the highly specialized nature of journeymen assignments, Oberg has established its own curriculum and provides its own teachers from within its plant, with occasional lectures by outside engineers, metallurgists and carbide specialists.

Unlike most apprentice programs, the curriculum is not confined to the purely practical aspects of die fabrication. Subjects such as the chemistry of tungsten carbide, punchability and diamond wheel structure are studied intensively. As a result, graduates of the class are well-grounded in every phase of carbide die construction and can be classified as skilled technicians rather than as grinder hands or toolmakers. Similarly, administrative personnel have excellent technical backgrounds.

Metallurgical Laboratory: In addition to the grinding and toolroom divisions, the company's administrative structure is rounded out with a metallurgical laboratory and an engineering department. The laboratory inspector, *Fig.* 1, makes detailed reports on incoming carbide and furnishes the grinding department with pertinent information on part sizes.

Size inspection is important since carbide shrinks approximately twenty percent during sintering. This shrinkage results from the use of paraffin as a temporary bonding agent in the mixture of tungsten carbide and cobalt. During sintering the paraffin burns out, shrinking the briquette of carbide and cobalt. If the part configuration is particularly complex the chance for an out-of-tolerance part is great but in many cases shaped die components can be saved by "favoring" one side of the section during grinding. If inspection indicates that the

Fig. 2. Die engineering department. Over ninety percent of the dies manufactured by Oberg are designed by the company.

component can be saved, the laboratory indicates the location and amount of favoring required.

Microscopic inspection also discloses areas in which the carbide is oversintered or undersintered. Either of these factors affects hardness and tool life, and consequently the efficiency of the die.

Engineering: Die designers in the company's engineering department, *Fig.* 2, use desk calculators to establish die dimensions. All die sections are dimensioned to the sixth decimal place.

Because the bulk of Oberg's work is in the field of lamination dies, the engineering department has evolved standards that are strictly adhered to in die design. Illustrated in *Fig.* 3, these standards provide maximum quality and they present solutions to many of the problems with which some designers may normally spend a great deal of time. The standards also enable a customer to visualize his completed die and, in some cases, to determine the purchase price. In effect, this procedure makes a notch type lamination die a stock item.

Most of Oberg's engineers are technically trained

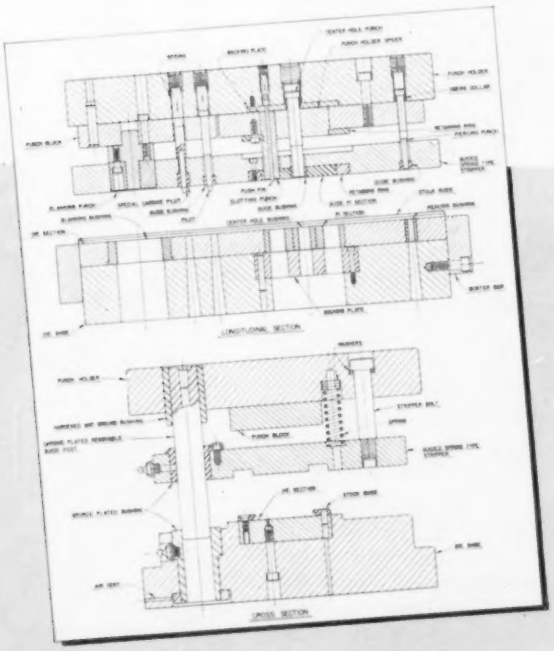

Fig. 3. Cross sections of lamination die. These views illustrate design standards of the company.

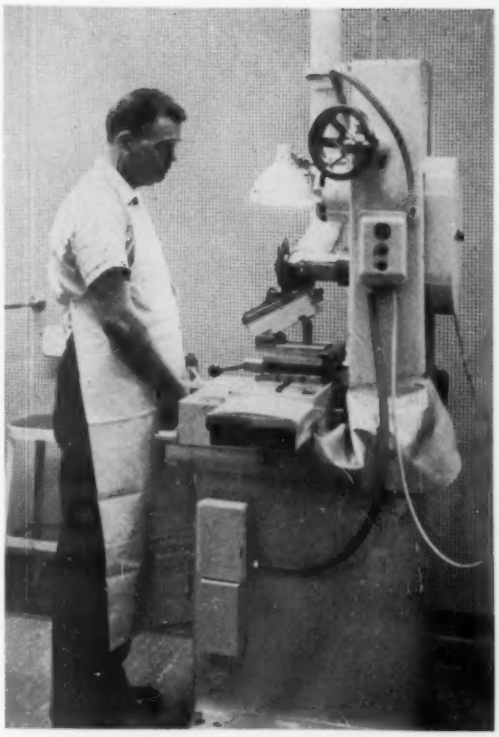

Fig. 4. Cubicle for finishing carbide sections. This room is designed for maximum operator comfort.

but the engineering department has not closed its doors to shop men. Grinder operators and toolmakers showing outstanding ability can and do enter engineering when vacancies ocur.

Grinding Department: Key to successful carbide die construction is the accuracy with which individual components are ground. Because most dies are constructed with interchangeable components, standards of accuracy must be more stringent than normal to eliminate possible accumulation of tolerance. In practice, these dies are not assigned conventional plus-and-minus tolerance. Instead each part is dimensioned to the sixth decimal place and grinder operators work directly to the required dimension.

Individual rooms are provided for each surface grinder, *Fig.* 4. These are soundproof, air-conditioned and well ventilated. Ventilation of the cubicles is necessary to keep work and inspection equipment free from impurities but air conditioning is strictly for the operator's personal comfort. Because carbide's coefficient of expansion is low—approximately half that of steel—normal tempera-

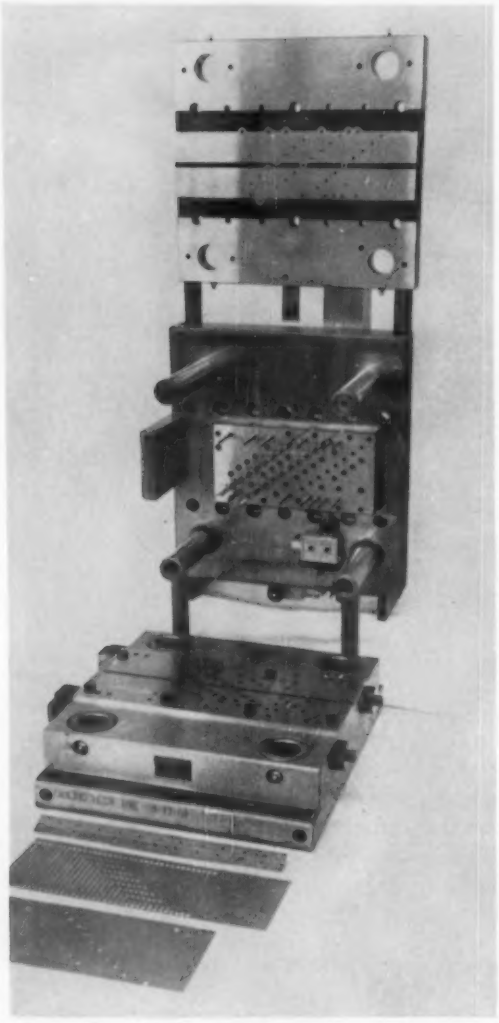

Fig. 5. Test die for experimental runs on carbide punches and die button. Notch at center is for Neoprene strip used to separate coolant.

ture fluctuations would have no appreciable affect on part size. Soundproofing is beneficial because carbide emits no sparks and operators must grind by sound. This sound—a low barely audible hiss—is the only indication that contact has been established between the wheel and the carbide workpiece. Contact is established in silence. When grinding begins, the operator can tune in popular and light-classical music on the intercom if he so desires.

Toolroom: When carbide components are finish ground, they are routed to the toolroom for final assembly in the die. The assistant plant manager is in charge of this department and, although at staff level, he is a close approximation to the die leader found in conventional shops. All dies are assembled under his immediate supervision, each die being assigned to an individual toolmaker when all components are complete. Because all components are thoroughly inspected, the dies go together like carefully tooled jig-saw puzzles.

In this way, old-fashioned craftmanship, an indispensible ingredient in the fabrication of most dies, is superseded by advanced die engineering and this essentially is the secret of the company's success. Each die is regarded not as an entity in itself but as an assembly of precision parts, each of which is made on a semiproduction basis.

To maintain its position of leadership in the field of carbide tools and dies, the company has instituted a program of continuous research and product development. Current research is devoted to finding improved grades of carbide for use in die manufacture. Because less than 7 percent of the total annual consumption of carbide is used in dies, suppliers have not emphasized research on carbide as a die material. Believing that this material can be improved significantly, Oberg has ordered limited quantities of carbide in which cobalt and tungsten carbide are mixed in preselected ratios. Punches and dies made from these special mixtures are mounted in a special die designed to test their endurance, *Fig.* 5. Each punch and die button is numbered for identification and after prolonged runs, they are removed for inspection.

Design of the die enables Oberg to test the effects of two different lubricants simultaneously in the center of the die. In this way, the lubricants— also specially prepared—can be introduced from each side of the die without danger of contamination with the other lubricant. Through use of this die the company expects to find the optimum combination of carbide and lubricant for any given material.

Oberg's research lab is currently engaged in establishing production methods for manufacturing stock punches and die buttons similar to those now produced from high-speed steel. These are expected to be used extensively in industry in conventional as well as in carbide-die applications.

Also of interest is a special machine shop now being set up for the machining of missile components. Tungsten, molybdenum, zirconium and columbium are some of the Space-Age materials that will be machined. These exemplify the company's manufacturing philosophy—shoot for the moon—but train the men you need to get you there, backing them up with engineering know-how.

REFERENCE SHEET

machining cobalt superalloys

By C. T. Olofson and F. R. Morral
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Table 1—Drilling Cobalt Superalloys

Alloy Designation	Size Drill (inch)	Tool Material	Feed (ipr)	Speed fpm	Other Remarks
G. 18B	0.10-0.50	HSS	0.0015-0.006	25-35	Alloy condition: aged. Use 28 deg helix angle and special points with four cutting edges.
Refractaloy 26 Refractaloy 70 Refractaloy 80 K-42-B	0.5	HSS	0.003-0.007	15-30	Alloy condition: aged. Use sulfochlorinated cutting oils
	0.75-2.0	HSS	0.003-0.007		Alloy condition: aged.
N-155 S-590				14-20	Use 135-140 deg included angle; 10 deg clearance angle; 1/3 web thickness of standard drill
	0.25-0.75	HSS	0.002-0.004		
Nimonic 90 Iconel 700 Udimet 500 M-252	0.63-0.25 0.25-0.75 0.75-2	HSS HSS HSS	0.0005-0.002 0.002-0.004 0.004-0.006		
Haynes Alloy No. 25					Use 135-140 deg included angle; 10 deg clearance, 1/3 standard web thickness. Soluble oil and lubricant added has been used
		Carbide tipped	0.001-0.003	12-20	
J-1570					
S-816 G. 34 Haynes Stellite 31 Alloy X-40		Carbide tipped	0.001-0.003	12-18	
Haynes Stellite 21		Carbide tipped	0.001-0.003	12-18	
Rexalloy 33		Masonry type carbide drills	Fine	Slow	Use a good coolant

MANY OF THE SUPERALLOYS containing cobalt are not difficult to machine if appropriate techniques are used. In general, high-quality machine tools, sharp cutting tools of appropriate design and material, low speeds and feeds, continuous cutting action and appropriate coolants are minimum requirements.

Cobalt superalloys exhibit solid-solution type microstructures with possible segregations of visible and submicroscopic intermetallics. At temperatures above 2100 F these constituents dissolve, forming a simple solid solution. The solid solution remains after quenching, but it is unstable and on aging, the insoluble constituents have a tendency to precipitate.

Drilling and Tapping: Drilling is the most difficult operation in the machining of cobalt superalloys. The point of the drill constantly rubs against the bottom of the hole, causing work hardening. Positive feed and sharp drills are essential. When drilling deep holes,

REFERENCE SHEET

it is advisable to resharpen the drill once or twice, depending on the hole depth. Because the wall of the drill work hardens to some extent during drilling, the use of pilot drills is impractical.

In tapping cobalt superalloys, three-flute high-speed gun taps have been used successfully and appear to be superior to four-flute types. The hook angle should be slightly larger than that used for tapping conventional materials. Special surface treatment applied to taps increases their resistance to abrasion and provides extended tool life. Hand tapping is preferred with the tap being advanced one half a revolution before reversing. Recommended lubricant for tapping cobalt superalloys is sulfochlorinated oil applied with a brush.

Turning and Facing: Operations involving turning and facing are relatively simple to perform on cobalt superalloys. High-speed steel, nonferrous cast alloy and carbide tools are used. When intermittent cuts are made high-vanadium, high-speed steels are recommended. The workpiece should be supported rigidly, positive feed should be maintained and cutting tools should be replaced before they become dull. The tool should never ride on the surface without cutting and on finishing cuts the tool should enter the stock below the work-hardened surface. Stress relieving is sometimes necessary after roughing operations.

Generally speaking, the work-hardening tendencies of the cobalt superalloys resemble those of austenitic stainless steels. Therefore, many of the machining techniques used for these steels are also applicable to cobalt super-alloys. On some of the alloys—Therlo, Rodar and Kovar A—too little information regarding machinability is available to include them in the accompanying tables.

Table 2—Turning Cobalt Superalloys

Alloy Designation	Material Condition	Tool Material	Roughing Speed (fpm)	Roughing Feed (ipr)	Roughing Depth of Cut (inch)	Finishing Speed (fpm)	Finishing Feed (ipr)	Finishing Depth of Cut (inch)	Cutting Fluid
Konal	Aged	Carbide	100-175	0.015-0.025					
		HSS	30-40	0.002-0.020	0.005-0.035				Soluble oil, 15:1
G. 18B		Carbide	150-175	0.010-0.020	0.125-0.75				
Refractaloy 26, 70, 80	Solution treated	HSS	40-65	0.003-0.008	0.031				Sulfochlorinated oils
		Carbide	67-105	0.008-0.013	0.05				
K-42-B	Aged	Carbide	—	—	—	75-120	0.006-0.010	0.011-0.015	
N-155	Aged	HSS	18-20	0.007-0.011	0.025-0.045	18-20	0.003-0.008	0.008-0.011	Sulfochlorinated oils
		Cast Alloy	20-40	0.007-0.011	0.025-0.045	20-40	0.003-0.008	0.008-0.011	
S-590		Carbide	50-72	0.008-0.013	0.050-0.100	68-90	0.006-0.009	0.011-0.015	
Nimonic 90	Solution treated	HSS	20-35	0.015	0.093 max				Heavy sulfur base or sulfochlorinated oils
Inconel 700		Cast Alloy	40	0.015-0.025	0.25 max				
Udimet 500		Carbide	30-45	0.008-0.013	<0.093				
M-252		HSS							
	Aged	Carbide	10-20	0.015	0.093 max				
		Carbide	60	0.008-0.018	0.187 max	30-50	0.003-0.008		
Haynes Alloy No. 25		HSS							
		Carbide	35-55	0.010-0.015		45-55	0.006-0.010		Soluble oil and lubricant
		Carbide	30-45	0.009-0.015	0.060-0.10	30-45	0.003-0.005	0.008-0.010	
J-1570	Aged	Carbide	35-55	0.010-0.015	0.063-0.125	35-47	0.004-0.009	0.031	
			30-40	0.008-0.013		50-60	0.005		
S-816	Aged	HSS	10-15	0.008-0.009		—	—		Sulfur or sulfochlorinated oil
G. 34		Carbide	25-35	0.009-0.012		—	—		
Cobenium; Elgiloy		Carbide	—	—	To insure	30-60	0.011-0.015		
HS-31		Carbide	—	—	a bite	30-40	0.005-0.008		
Alloy X-40									
HS-21		Carbide	25-35	0.009-0.012	0.25	30-40	0.005-0.008	—	General-purpose cutting oil and kerosene
		Carbide	10-40	0.015 min	0.25	65	0.008	0.005	
Rexalloy 33 (55 R_C max.)		Carbide	25-40	0.003	0.010-0.020	Generally finished by grinding using light feeds with wheels having 46-60 grits and hardnesses of X or J			None

Economy in Manufacturing

news

astme in action

news section

features

Techtours and Toronto Sights Highlight Semiannual Meeting 115

Economy in Manufacturing 116

Members in the News 118

The Story of Numerical Control 118

Referendum Ballot Tallied: LRP Changes Win by Landslide 119

Moreland Represents ASTME in Patent Celebration 119

Hartford Serves Seminar on Silver Platter 120

Giordano Joins TME Staff as Associate Editor 120

chapters

Binghamton 123

Catskill Region 123

Chattanooga 121

Cincinnati 122

Columbus, Ind. (proposed) 123

Hartford 120

Kansas City 123

Mohawk Valley 123

Phoenix 123

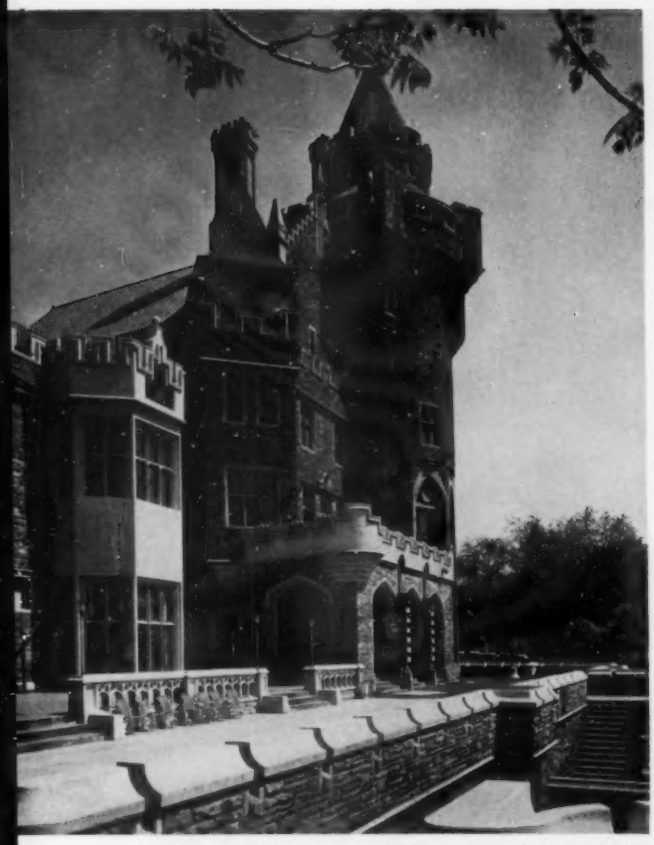
Springfield (Mass.) 123

Sydney 122

Syracuse 123

Techtours and Toronto Sights Highlight

Semiannual Meeting



High on the list of famed Toronto sights is this 98-room medieval castle situated in the heart of the city. Built to entertain royal guests, the Casa Loma has towering battlements, a secret staircase, underground tunnels and a stable with Spanish-mahogany stalls.

On Oct. 26-27 Toronto will roll out the red carpet for ASTME's Semiannual Meeting, for the second time in Society history. Just 20 years ago the city played host to the organization's ninth Semiannual Meeting, the first ever held in Canada.

As a royal welcome-back for the semiannual event, the ASTME Toronto hosts will stage an outstanding two-day program at the city's Royal York Hotel. The technical side of the festivities will carry out the main theme of the meeting—"Economy in Manufacturing"—with three Techtours.

During the first Techtour, Thursday, Oct. 26, economy in plant planning will be discussed by the Canada Cycle and Motor Co. plant manager, D. H. Connell. The talk will describe how the CCM plant was completely reorganized to facilitate production. Later, registrants will visit the plant for a look at the results of this reorganization program.

Another speaker on plant planning economy, Ian Leslie of Canadian Acme Screw & Gear, Ltd., will explain how a new plant can be, literally, built within the walls of the old. The principles discussed in this paper will be illustrated during a tour of Canadian Acme.

On Friday, Oct. 27, visits to the Canadian Kodak plant and the DeHavilland Aircraft facilities will depict economy in design and engineering. One of the papers at this session will describe the development of DeHavilland's Caribou airplane. The other will deal with a new outward compression type gasifier that is more simple to manufacture than those now used in industry.

The final Techtour, also on Oct. 27, features economy in production. In the morning Francis M. Mallee, research engineer for The Budd Co., will tell of a plastic sheet that can be cold die formed. In the afternoon registrants will see economy in production in action at Massey-Ferguson, Ltd.

At the close of each Techtour, the papers and plant visits included in that session will be fully discussed. A few of the views in store for Semiannual Techtourers are pictured on the next two pages.

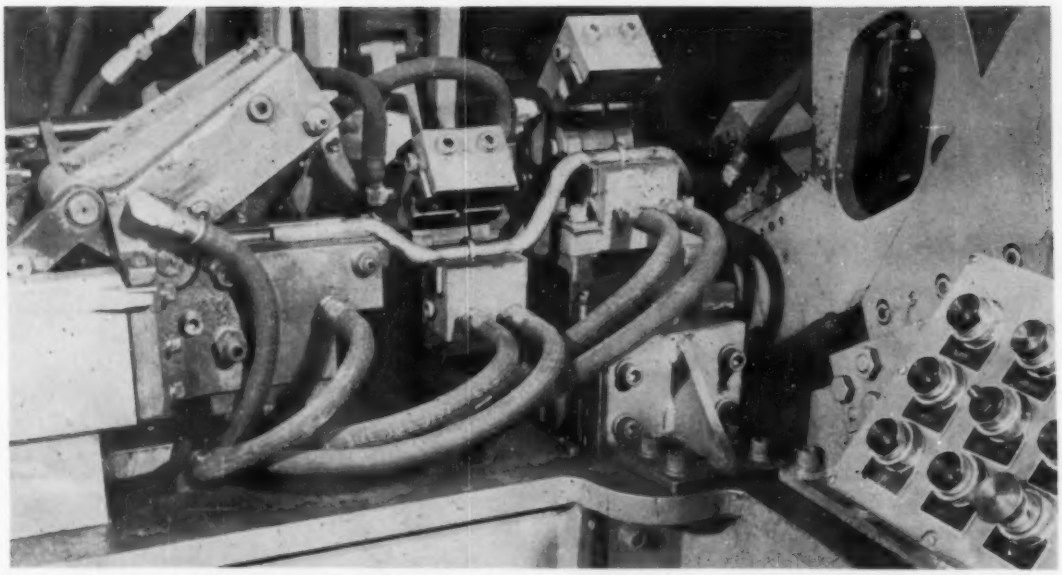
Most of the meeting's activities require advance registration. *For information, contact the Convention Manager at Headquarters in Detroit.*

In switching to the less technical side of the festivities, the spotlight turns on the Canadian metropolis itself. Toronto-seeing is a must for all ASTME visitors, and among the musts on the list of sights-to-see are: the historic Parliament buildings, where some of the world's largest nuggets of precious metals are displayed in the corridors; financial Bay Street, Wall Street's Canadian counterpart; the elegant, exotic Casa Loma castle; the new $12 million O'Keefe Centre, largest auditorium in Canada; and the Royal Ontario Museum with its world-famous Chinese collection.

Connoisseurs in the sight-seeing department, the ladies will have among their many activities a specially planned tour of Toronto on Oct. 26.

Also on the program is a two-day meeting of the Society's Board of Directors plus two social events. On the opening night of the conference a Host Committee Party will welcome all registrants. On the closing night is the Semiannual Banquet complete with social hour and entertainment—a fitting conclusion for ASTME's return to Toronto.

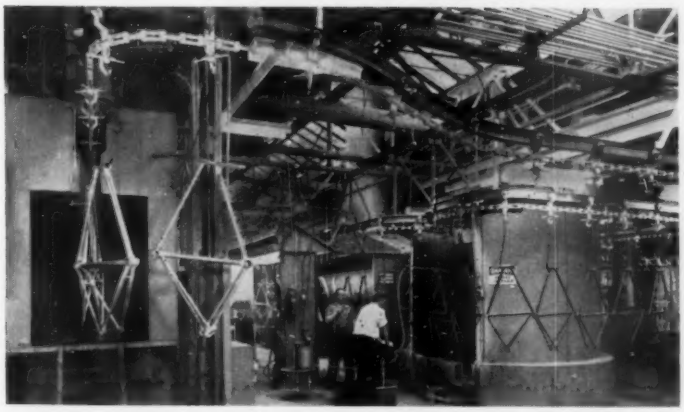
ECONOMY in Manufacturing



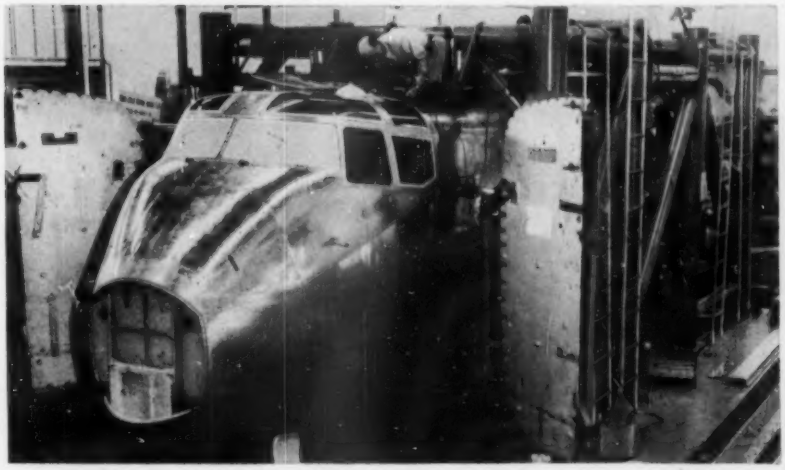
ECONOMY in production, an ASTME Techtour of the Toronto Massey-Ferguson plant, will give Semiannual Meeting registrants a look at such new manufacturing techniques as this electro-conduction method of forming crank shafts from bar stock. The tour will feature the plant's special equipment and processes developed for the manufacture of large farm machinery such as combines and balers.

ECONOMY in plant planning, the opening Techtour for the Society's Semiannual Meeting in Toronto, will illustrate "line production" operations during a tour of Canadian Acme Screw & Gear, Ltd. The specialist lines pictured here facilitate the production of spiral and hypoid bevel pinions for cars and tractors.

ECONOMY in design and engineering will take the spotlight during the Semiannual Meeting Techtour at Canadian Kodak's Toronto plant. Besides the operation shown here—the mixing of an emulsion coating made from silver, chemicals and gelatin—visitors will see the many other steps involved in the production of photographic film and paper, from raw materials to finished products.



ECONOMY in plant planning is well depicted by this completely conveyorized enameling department at the Canada Cycle and Motor plant, host for the Semiannual Meeting Techtour on plant planning. Those who visit CCM will inspect the five-stage phosphating unit shown here and tour the manufacturing facilities for the world-famous Tackaberry professional hockey boot.



ECONOMY in design and engineering is the major theme of the Semiannual Meeting paper on Caribou aircraft and the corresponding tour of the Caribou production line at De Havilland Aircraft of Canada, Ltd. At the right is the front fuselage section of the DHC-4 Caribou plane.

EDWARD W. DICKETT (left), Rockford chapter member, was recently elected to Life Membership in the Society by the House of Delegates. A former ASTME vice president and director, he was the first chairman of Rockford chapter and has served on several Society committees. Here, Past President H. Dale Long congratulates Dickett on the high honor accorded him.

Members in the News

The newly created post of director of bearing sales at Freeway Washer & Stamping Co. has been filled by Cleveland chapter member JOHN R. POPOVICH. He has been with Freeway since 1949.

In his new position as product planning manager of the industrial department at Vickers, Inc., R. J. RENDER will be responsible for administrating and coordinating all activities concerned with market planning and introduction of new products. Render is a member of Detroit chapter.

Two members of Boston chapter have been appointed to new positions at Lapointe Machine Tool Co. JOSEPH P. CROSBY, president of the Society during 1954-55, became vice president-director and JAMES W. DOPP assumed the duties of vice president of sales. Crosby, a past chairman of Boston chapter who has served on the Board of Directors and the Society's Progress Committee, will also direct the sales policies of Lapointe's subsidiary, Lapointe Machine Co.

Headquarters recently received word of the death of ARTHUR J. DENIS. A past chairman of Los Angeles chapter, Denis served on the ASTME Board of Directors from 1946-48.

CHARLTON A. BROWN, past chairman of St. Louis chapter, recently assumed the duties of assistant works manager at Emerson-Imperial Lighting Co. in Latrobe, Pa. Previously he was with the E & A Mfg. Div. A past member of the Editorial Committee, Brown is now on the Membership Committee.

The Story of Numerical Control . . .

The full numerical control story, put between covers by THE TOOL AND MANUFACTURING ENGINEER, has won wide recognition in industry. An authoritative reference work on NC's past, present and future, *Numerical Control Today* was published by the magazine staff about a year ago. Several thousand copies of the book were distributed throughout industry, and ever since, letters of appreciation and requests for additional copies have been pouring in from interested persons in all parts of the country.

The book's 100-plus pages are divided into three sections which cover a broad range of numerical control systems and applications. "Management Analysis and Strategy" and "Putting NC to Work" consist of a score of illustrated articles taken from recent issues of TME; "Background Reading" includes a half-dozen papers presented on the subject at ASTME annual and semiannual meetings. A few copies are still available and will be sent, without charge, to Society members upon request.

Referendum Ballot Tallied:

LRP Changes Win by Landslide

THE FINAL TALLY of returns in the recent referendum shows a landslide vote of approval for the constitutional changes proposed by the Long Range Planning Committee. A 12-to-1 majority of ASTME voters endorsed the LRP changes, according to the official referendum results announced on Sept. 16 by Society Secretary Arthur Cervenka and tallied by tellers Francis J. Sehn and Charles M. Smillie. Of the 10,793 ballots cast, 9970 were in favor and 823 were opposed.

Due to the referendum approval, the LRP changes go into operation immediately. Effective Oct. 1 are amendments to 13 of the 28 articles in the Society's Constitution. Most significant among these amendments are the changes in membership qualifications and the lengthening of the directors' term of office.

In accordance with the new membership qualifications—which pertain only to future applicants, not to present members—the age and experience required for Senior Membership are increased; a Regular Member grade replaces Junior Member; and the experience required for membership in that grade is increased. The new look in membership requirements is outlined in detail in the August issue of THE TOOL AND MANUFACTURING ENGINEER.

Another outcome of the referendum, the new procedure for election of the board stipulates that the House of Delegates will each year elect seven directors for a two-year term of office. Thus, seven of the board members will be newly elected each year; another seven will have at least one year's experience on the board; and the fifteenth director will continue to be the retiring Society president.

To implement the new procedure, the delegates will elect 14 candidates to the board in 1962. The seven who receive the highest number of votes will serve for two years and the other seven, for one year. Thereafter, seven directors will be elected each year for a two-year term of office.

Also effective Oct. 1 is a $5 increase in the annual dues of Senior, Associate and Regular members. Approved by the board at the Annual Meeting in New York, the raise in dues is explained in an article in the August issue of this magazine.

Referendum Response Shows Member Interest

Perhaps the most important part of any referendum is the member's democratic right to vote, to have his say in his Society. About 30 percent of the qualified members exercised that right in the referendum just past. While this response indicates substantial member interest in the current constitutional changes, the fact that 90 percent of the voters favored the changes leaves no doubt about member support.

Moreland Represents ASTME in Patent Celebration

AS THE REPRESENTATIVE of 41,000 industrial engineers and executives, ASTME President Wm. Moreland is serving on the National Sponsoring Committee for the anniversary celebration of an institution that is a vital stimulus to industrial skill —the American Patent Incentive System. The celebration commemorates the 125th anniversary of the Patent Act of 1836.

Along with other U. S. leaders in the fields of science, technology and government, Moreland was invited to serve on the sponsoring committee by Chairman Vannevar Bush, retired president of Carnegie Institution of Washington.

The celebration activities, under the direction of the U. S. Department of Commerce and the Patent Office, will culminate in a three-day program on Oct. 18-20 in Washington, D. C. The heads of patent offices of 63 countries have been invited to attend the program, which is keyed to the theme of the Patent System and modern economy.

William H. Gourlie

Hartford Serves Seminar on Silver Platter

HARTFORD chapter's silver anniversary celebration on Oct. 3 is a strictly silver-platter affair. The main course—a full-day seminar covering the design, manufacture, inspection and application of unified screw threads—will be served by an internationally famous panel of experts on standards and screw threads. As a special side dish, the chapter has planned a tool exhibit of some 50 educational and industrial displays. And topping this technical repast is a gala evening banquet in honor of the group's 25 distinguished past chairmen. Society President Wm. Moreland will add the final touch with his keynote address.

Invitations to the high-class celebration, however, are not exclusive. According to the chapter, the event marks two silver anniversaries: 25 years of association with ASTME and 25 years of industrial leadership in the local community. Thus, the program has been planned to advance the technical knowledge of not only chapter members but all other interested people in the area.

In fact, the seminar subject was chosen because of its everyday interest to the majority of Hartford citizens involved in manufacturing. Admission to the session requires only a reserved ticket, which costs no more than the call to reserve it.

A special on the seminar menu is the discussion of industrial screw standards by General Motors' director of engineering standards, R. P. Trowbridge. Another featured item is the explanation of screw standards for the national services, to be presented by I. H. Fullmer from the National Bureau of Standards in Washington, D. C. These two speakers plus four other panelists have just recently returned from Europe where they participated in programs for the advancement of international screw standards.

Chairman of the seminar, William H. Gourlie, is the chapter's No. 1 man on standards. Besides heading the ASTME group's standards and data committee, he has been an American delegate to International Standardization Organization Conferences and has twice served as chairman at other international screw threads conferences.

Judging from the technical flavor of this silver anniversary celebration, Hartford Chapter 7 should maintain its industrial leadership for another quarter-century, at least.

Giordano Joins TME Staff as Associate Editor

EDITOR JOHN W. GREVE recently announced that Felix M. Giordano has joined the staff of THE TOOL AND MANUFACTURING ENGINEER as associate editor. Giordano comes to TME from *Product Engineering* magazine where he has been regional editor for the past four years and, before that, assistant editor in charge of manufacturing processes.

Prior to his work in the editorial field, Giordano was associated with the Curtiss-Wright Corp. in Wood-Ridge, N. J. After starting as a metallurgical technician, he was promoted to metallurgist and later became head of foundry development metallurgy. In addition, he spent several years as a lecturer at Columbia University.

A graduate of Columbia, the new associate editor holds a B.S. degree in engineering, an M.A. in Romance languages and a Ph.D. in Romance philology.

special events

Hartford Chapter Seminar "Unified Screw Threads"	Oct. 3 1961	Hotel Bond Hartford, Conn.
Wisconsin Council of Chapters' On-Campus Conference	Oct. 7 1961	Dominican College Racine, Wis.
ASTME Seminar "Manufacturing with Space Age Materials"	Oct. 10-11 1961	Sheraton Hotel Philadelphia, Pa.
ASTME Semiannual Meeting	Oct. 26-27 1961	Royal York Hotel Toronto, Canada
Illinois Council of Chapters' 11th annual On-Campus Conference	Oct. 28 1961	Augustano College Rock Island, Ill.
ASTME 1962 Engineering Conference	May 7-11 1962	Statler Hilton Hotel Cleveland, Ohio
ASTME 1962 Tool Exposition	May 7-11 1962	Public Auditorium Cleveland, Ohio

Chattanooga Has an Eye on Tomorrow

CHATTANOOGA, Tenn.—During Chattanooga chapter's chartering ceremony last year, H. Dale Long, then president, told the new group: "Membership in ASTME provides a means of keeping up with the latest manufacturing techniques." At that time Chapter 167 was already planning the recent seminar which marked its first anniversary.

Cosponsored by the University of Chattanooga, this seminar—"Metal Forming for Tomorrow's Manufacturing"—was an effective manifestation of Long's words, its main theme being how processes, techniques and materials of today will be able to meet the demands of tomorrow. An audience of 115 attended, including representatives from 25 companies as far as 450 miles away. Registrants heard seven technical speakers talk on subjects geared to meet the needs of today and tomorrow—a space age tomorrow which will demand new methods, new processes and in turn new materials and which will more than ever demand that all those in the metalworking and allied industries keep up with the latest manufacturing trends.

Speaking on chipless machining, Richard A. Paulton, The Cincinnati Milling Machine Co., said that greater economy, a desirable increase in physical properties and grain structure, plus the ability to manufacture the new shapes necessary in this day of missile and space vehicles, were three basic factors which pinpointed the advantages of the process. Those attending the session on cold extrusion were told of its theoretical aspects by John V. Russell, Republic Steel Corp.

The afternoon program, following a luncheon talk by E. C. Pitt, vice president of Hamilton National Bank, began as J. R. Innis, chief applications engineer for Cincinnati Shaper, spoke on special features and variations of press brake forming. Innis said that the press brake is an unusual machine among the metal-forming tools of today, having as one of its strongest advantages wide flexibility of physical characteristics built around a small number of basic well-proved designs.

Turning from processes and techniques involved in metal forming for tomorrow's manufacturing, Paul A. Kruesi of Bitro Chemical placed the spotlight on materials. Choosing titanium, columbium and beryllium as examples, he told of their respective advantages and importance to future industry.

Closing speaker, Fred A. Douglas, Jr., discussed the development, economics, specifications and attachments of the transmat feed press. Douglas, who is with Verson Allsteel Press Co., said annual production of the transmat is roughly 1,000,000 pieces, with each piece requiring at least three operations.

Are You Inventing More Now, Enjoying It Less?

Try entering the 1961 Gadgets Contest. One of those ingenious devices you invented to solve a production problem may win a cash prize—which is sure to be enjoyable.

The contest is open to all ASTME members and offers one blue-ribbon award of $100, two second prizes of $50 and four third prizes of $25, plus numerous honorable mention bonuses of the *Die Design Handbook* or *Tool Engineers Handbook*. That first prize is $100 and, regrettably, not $1000 as listed in last month's issue.

Each entry—submit as many as you like—should include a simple sketch or photo of the gadget plus a brief description of how it works and should be sent to the Gadgets Editor of this magazine. But hurry! The competition closes Dec. 31.

New Research Report on Metal Stamping

The Society's newest research report is the result of a careful re-evaluation of the mass of data collected by the Metal Stamping Project Committee. In 17 pages it covers what the committee believes to be the best of the large number of ideas presented during its study of electrical steels, punch and die steels, and presses and their auxiliary equipment. The suggestions in this report, says the committee, can be followed with a better-than-average chance of success.

Titled "Metal Stamping Project Committee Findings on Electrical Steels, Punch and Die Steels, Presses and Auxiliaries in Metal Stamping," the report is the 31st to be issued by the ASTME Research Fund. Society members may purchase copies for 75 cents and nonmembers, for $1.50.

High Points in the Sydney Season of Activity

SYDNEY, Australia—It's winter in Australia and, while most chapters in North America have been enjoying an interim of inactivity, Sydney chapter is in the midst of a most active season. Recent technical meetings have featured discussions of lamination dyes and laminations, numerical control and tapered roller bearings.

W. M. Este of the Sankey Div. of John Sysaghts, emphasized the importance of material, tools, material handling, quality control and inspection as he spoke to Chapter 144. Cost factors, press utilization and output rates were then presented to the Sydney group in graph form.

Explaining the basic principles of machine control by tape and computers and the preparation of data from drawings, R. C. Cook, Electronics Cir., E.M.I. Australia, Ltd., showed some of the whys and hows of numerical control. His talk, heard by 100 members of Sydney chapter, was followed by a visit to E.M.I. where the group saw a vertical mill operating under the guidance of numerical tape.

In another recent lecture, Ken Butterworth of Timken Bearings traced the history, development and manufacture of tapered roller bearings from the original design of 1802 to that of the present day. *—George J. Moulang*

Tool Engineer's Place in National Defense

Chapter officers and guests attending Cincinnati's recent 23rd annual dinner meeting are (seated left to right): Gen. David M. Jones; Frank Houston, past chairman: Frank Kutz, chairman; Philip Marsilius, ASTME vice president; (standing left to right), Norman Ahlgrim, secretary; Val Anzalone, second vice chairman; Charles Cramer, treasurer; and Joseph Williamson, first vice chairman.

CINCINNATI, Ohio—When General David M. Jones recently addressed some 400 members and guests attending Cincinnati chapter's 23rd annual dinner meeting, he explained the place of the tool engineer and manufacturing in national defense. Jones, who is vice commander of the aeronautical systems division at Wright Patterson Air Force Base, also gave a brief outline of his various duties with the airforce.

Earlier in the evening Frank Kutz, chairman, presented the past chairman's pin to Frank Houston who gave a brief synopsis of the chapter's past year.

Also participating in the evening's program was Philip Marsilius, Society vice president. *—C. Keller*

Syracuse Told of Tomorrow's Transportation

SYRACUSE, N. Y.—Homes with their own airpads plus airplanes that depart like huge aerial elevators from the hearts of metropolises were two pictures of a fascinating world-to-come which Donald Ordway described to 150 Syracuse members and their sons at the chapter's recent Father and Son Night. Ordway, who is head of the Aerophysics Section of Therm, Inc., told the group how VTOL flight vehicles, a class of aircraft having the delineating capability of vertical take-off and landing, can solve some problems of future transportation. Presently, he said, most of our day-to-day travel is in vehicles which follow paths upon the surface of the earth, or slightly below or above it. This one-dimensional transportation has recently become partly three-dimensional through the advent of such crafts as the jet and the submarine. But, with the imminency of a population explosion, there will be complications associated with their departure and arrival.

The solution—VTOL—is an innovation that began with Leonardo da Vinci's invention of the helicopter and has since led to such VTOL vehicles as the tiltwing, the convertiplane, the GEM, the aerodyne and others. *—Ed Luis*

Donald Ordway (left) points out some interesting principles of vertical take-off and landing craft to Syracuse chapter members and their sons.

Past President and Educator Speak at Phoenix

PHOENIX, Ariz.—Jim Rost (right), chairman of Phoenix chapter, introduces Harold E. (Rip) Collins, past president of ASTME, to A. G. Foster (left) of the University of Arizona. Collins spoke to the chapter on American and foreign tools and machines; Foster gave a brief talk on high school drawing contests. *—Jim Peterson*

Reports in Brief . . .

Northeast

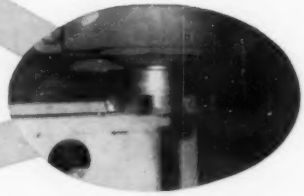
BINGHAMTON chapter heard a panel of three industrial leaders call upon engineers to assume a more vital interest in civic affairs. During their discussion Frank Paul of IBM, Raymond Mills of Endicott-Johnson Corp. and Wayne W. Cawley of Cadre Industries, said that future industrial growth and prosperity in the Triple-Cities area hinge on the attitudes of engineers and people with similar jobs. . . . D. S. Weed of the command control center at IBM, recently spoke at a CATSKILL REGION chapter technical session. His topic was manufacturing problems and techniques related to computers of the future. . . . SPRINGFIELD (Mass.) chapter has presented its scholarship award to James Skowera who is attending night school in pursuit of a mechanical engineering degree. Skowera, the father of four children, works days and is carrying a straight "A" average in his studies. . . . On Oct. 21, 1961, MOHAWK VALLEY chapter will present a seminar on numerical control. Speakers who will trace numerical control's past, describe its present and predict its future are C. E. Kinney, Hughes Co.; James Childs, Thompson-Ramo-Wooldridge Products Co.; and Richard Stilt, Numerical Machine Co.

Midwest

An attractive 16-page bulletin has replaced KANSAS CITY chapter's 8-page meeting announcement. The new publication, which sports an over-all view of the city on its cover, was designed to provide expanded chapter news coverage. . . . The proposed COLUMBUS, Ind., chapter recently elected pro-tem officers: Dudley Barton, chairman; Ray Fortmeyer, first vice chairman; W. Gardner, second vice chairman; J. Inglis, secretary; and R. Gilbert, treasurer.

Precision finishing

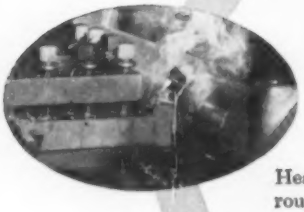
All around your shop...



General purpose machining

Finishing or light roughing

16 V-R carbide grades give complete machining flexibility



Heavy-duty roughing

Each V-R carbide grade is created with its own special combination of hardness, toughness and heat resistance. Sixteen such individual grades, plus a ceramic grade, bring you complete machining flexibility. You'll find the exact combination of tooling characteristics for your job regardless of the operation to be performed or the material to be machined. V-R's rigid quality control assures you of the same consistent, superior performance every time. Ask your V-R man to help you select the V-R cutting tool that's best for your job.

VASCOLOY-RAMET CORPORATION
888 Market Street, Waukegan, Illinois.

Interrupted cuts

V-R FIRST CHOICE in more and more plants

C-852

Progress in Production

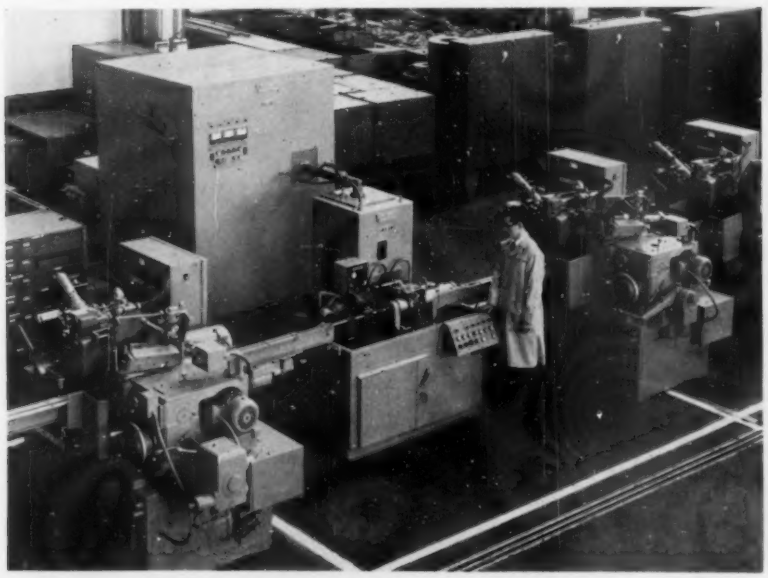
CONTINUOUS LINE COMBINES GRINDING, HARDENING OPERATIONS

Six units—an induction hardening machine and five centerless grinders—make up this continuously operating production line. Built by the Cincinnati Milling Machine Co., it processes workpieces at the rate of 12 fpm or 960 parts per hour.

At the beginning of the line, a hopper feeds the shock absorber piston rods into the first centerless for primary grinding, removing about 0.006-inch stock. The next machine is a 50-kw induction heating machine. At the work station of this machine, a feeding device continues the forward movement of the parts while simultaneously rotating them.

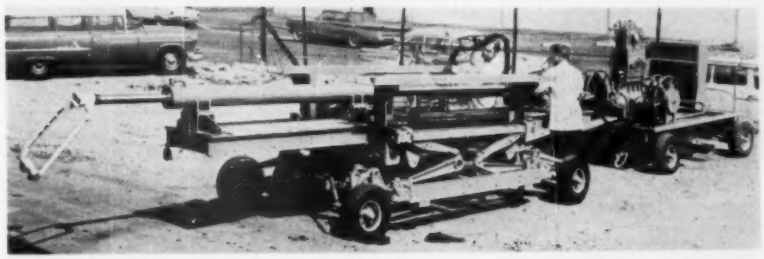
Since the ends of the rods must remain soft, heat is restricted to the center section. As each rod reaches a predetermined point, a part presence sensing device sends a signal to energize the induction coil through which the rods pass, producing a brief, accurately timed heating cycle for each part. The rods continue through an adjacent quench ring, resulting in a uniform 50 Rc case, 0.020 inch deep.

From the induction heating machine, parts are automatically conveyed to four in-line centerless grinding machines for finish grinding. Stock removed by the machines is 0.004, 0.002, 0.001 and 0.0005 inch, respectively.



Each hour, 960 piston rods pass through this production line for primary grinding, hardening and finish grinding operations. Six units make up the line.

LIQUID LATHE CUTS EXOTIC METALS



Thrust through the left end of this machine, a jet of liquid bombards missile interiors to cut propellant materials loose from the casings.

Traveling at supersonic velocities through an orifice no larger than a pencil lead, a needle-like jet of water, plus additive, cuts and removes defective solid propellant grain from rocket casings so that the casings can be salvaged and used again. The necessary pressure—approximately 15,000 psi—is generated by a machine resembling a cannon, the liquid lathe.

The machine controls both the motion and the rate of motion of the cutting nozzles as they work within the casing. It is capable of two motions—one through the hollow centerline core and one around the centerline. These automatic motions, combined with manual adjustment of the offset displacement of the nozzle cutting-head from the missile centerline, permit cutting either "doughnuts" or helical shapes.

In addition to cutting the explosive material, which has truck tire consistency, texture and toughness, the method has been used to cut concrete and large blocks of wood. Models for cutting and shaping metals and other materials such as titanium and stainless steel are under development.

Manufactured by Abrasi-Jet Machine Tool Corp. under license from its designer, Navan Products Inc., the machine operates by pushbutton control. It has one pump for a low-pressure oil hydraulic system, which produces linear and rotational motion of the nozzle holder or cutting head, and a second pump for high-pressure delivery of the cutting fluid.

UNIT CONVERTS LATHES TO TRACER MACHINES

Almost any standard lathe can be converted into a versatile, high-performance, production tracer to handle both ferrous and nonferrous workpieces ranging from simple axle shafts to complex configurations—in either intermittent job-shop or long-run operation—with this tracer-control conversion unit. The unit, with repetitive

motion, tracing, and positioning accuracy within 0.0002 inch, can be used on either horizontal or vertical machines.

Designed by Detroit Broach Machine Co. to control both carriage and cross slide of the machine from a single tracer valve, the unit enables a converted machine to generate any contour with surface finishes of 63 microinches or less. Its hydraulic system maintains complete command, controlling the cutting tool throughout the machining cycle, with constant feeds and speeds. This lengthens tool life by eliminating danger of tool breakage or burning.

Change-over from one similar job to another takes only the few minutes it requires to change templates. Regardless of the workpiece configuration, the relationship of the tool to the template is always constant. Hard or soft spots in the workpiece do not affect dimensional accuracy because of the constant pressure maintained on the stylus. Tool wear is compensated by a slide that positions the stylus.

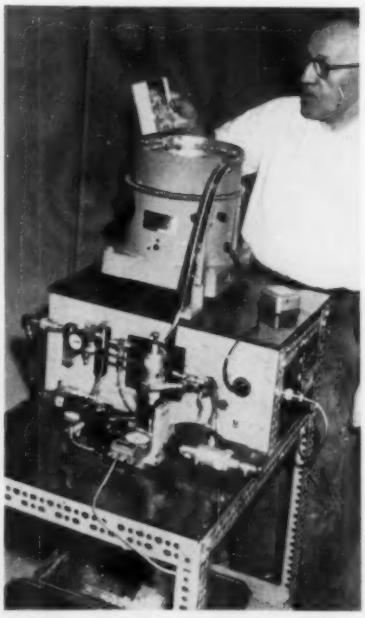
MACHINE INSPECTS TOLERANCE OF SMALL PARTS

The tedious and often costly job of providing 100 percent inspection of small parts has been overcome by Synthane Corp. with the development of a new small parts inspection machine. It sorts and checks up to 10,000 parts per hour.

The device was conceived originally as a quality control check for rubbing blocks for automotive ignition components. The rubbing block is an angle machined from molded laminated material. The length of the angle of the piece must be held to very close limits.

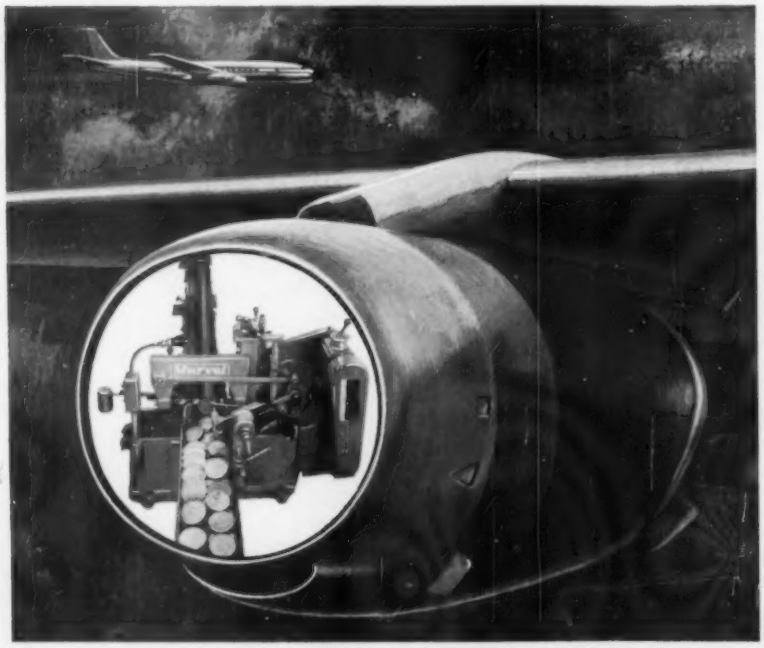
In checking the lengths on the new machine, the angles are placed in a vibrating hopper which feeds the pieces into a track. They drop of their own weight between the faces of a gage which, in turn, checks each angle for length and drops it into one of two pans. One pan receives the acceptable pieces, the other, rejects.

Every angle inspected is recorded by means of a counter which makes it possible to check the percentage of rejects to acceptable angles. This information is then used to make necessary adjustments in the cutoff operations.



Small parts are dropped from a hopper into position between the faces of a gage which check the part for tolerance adherence.

The machine has also been rigged with an air-actuated drill press to facilitate drilling of rivet holes in the angles. The angles are dropped in the track and a plunger at the end of the track feeds them under the press.



TOO SLOW ?

Emphatically not! . . . ask any visitor to the 1960 Machine Tool Exposition who watched a Marvel No. 6 Hack Saw Machine cut-off 3¼" diameter 1018 steel in 27 seconds! This Saw, costing less than $3000, was actually cutting at the rate of 18 square inches per minute!

We made the above demonstration merely to "match" what we believe to be the impractical demonstrations of some of our competitors. OUR visitors were warned that continuous cutting at this speed is economically impractical if maximum blade life and accuracy (after the first 20 cuts) are desired. They were told that the material could be cut day in and day out, at the rate of 8 square inches per minute with tool cost of approximately 1 cent per cut.

Our point? Marvel No. 6 and No. 9 Series Heavy Duty Ball Bearing Hack Saw Machines, as we build them today, have speed to spare. And they offer the most accurate, economical cut-off at the lowest initial investment.

Ask your Marvel Dealer to arrange a sawing demonstration—on your own work—if you wish. Because we have consistently built both Hack Saws and Band Saws for more than 40 years, you will get an unbiased recommendation.

Catalog C60 illustrates and describes the complete line of Marvel Sawing Machines. Write for your copy.

MARVEL Metal Cutting SAWS

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BETTER BLADES

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TOOLS of today

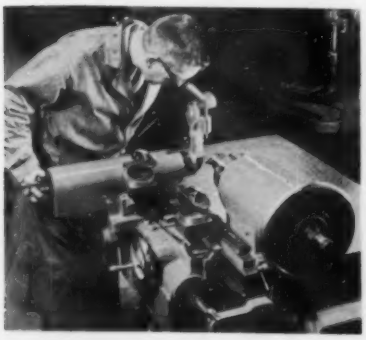
Table Drive Eliminates Backlash

With the Gyro Rate table drive, a small servomotor is coupled to a rate table to produce bidirectional drive of the table without backlash. Table response to the servomotor is instantaneous due to the low reflected inertia of the table to the motor. The table drive is supported on two pivot points and is spring-loaded against the table gear. A dual gear drive is used between the servomotor pinion and the output gear. This high ratio gear train is loaded or strained to provide a constant residual strain torque. A synchronous motor can be clutched into the gear train to provide preselected rates for the table of 1, 8, 12, 16 or 40 revolutions per day. When the synchronous motor is driving, the servomotor is driven. When the servomotor is driving, the synchronous motor is declutched. When the table is turning at 1 revolution per day, the servomotor turns at 28 rpm.

United Control Systems, Inc., 918 Woodley, Dayton, Ohio. **Circle 401**

Tool Presetter Uses Optical Measurement

Boring bars, milling cutters and drills can be preset for both diameters and depths in this machine. Capacity is 8 inches diameter, 18 inches depth. The tool is mounted in a spindle at the top of the machine base for setting. There are two coordinate positioning slide elements—one that moves parallel to the spindle axis and one that moves normal to the spindle axis. One slide provides for control of diameter settings, the other, for control of length settings. The slide elements are equipped with Vernac direct reading optical measuring instruments that can be read directly to 0.0001 inch without interpolation. Coarse and fine handwheel controls move both slides.



Microbore Div., DeVlieg Machine Co., Royal Oak, Mich. **Circle 402**

Grinding, Cutting Fluid Minimizes Heating

Frictional heat is reduced by the lubricating factor of Mastercut, an oil-base, water-soluble grinding fluid. Internal heat brought on by shock and stress is also reduced. The oil controls rust and rancidity and contains no sulphur, chlorine or phenols.

S & S Engineering Co., P. O. Box 158, Northville, Mich. **Circle 403**

Tape-Controlled Lathes Turn Complex Contours

Shown here in the final stage of production are six continuous path, tape-controlled lathes for turning complex contours as well as straight turning. Called "Tape-Turn," the lathes are 20-hp models, available with 30 or 90 spindle speeds from 22 to 1000 rpm and with motor speed variations in 4:1 or 20:1 ratios. General Electric Mark Century solid state numerical control units are used. They have a built-in computer for linear or circular interpolation for handling all types of cuts. The 3, 4 or 6-station turrets are completely interchangeable to allow preset tooling. Twelve-position indexing of the turret allows placement of any tool for machining all types of workpiece geometry. Tool offset compensation on both axes is provided in 0.0001-inch increments.

R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. **Circle 404**

Milling Head Designed For Fast Cutting

With 30 to 40 hp applied directly to the cutter spindle, the Speedmiller removes metal at a rate faster than 3 cu in per minute per horsepower. The

USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

machine has 10 speeds from 37 to 900 rpm for milling any material from cast iron to stainless steel. All gears have helical crown-shaved teeth and are in constant mesh. To achieve low overhung weight essential for planer conversions, the machine's transmission housings are aluminum alloy, with the spindle centerline only 5½ inches from the rail plate mounting face. Adjustment of the cutter height is done without raising or lowering the motor and ram.

Veet Industries, 25753 Groesbeck Hwy., East Detroit, Mich. **Circle 405**

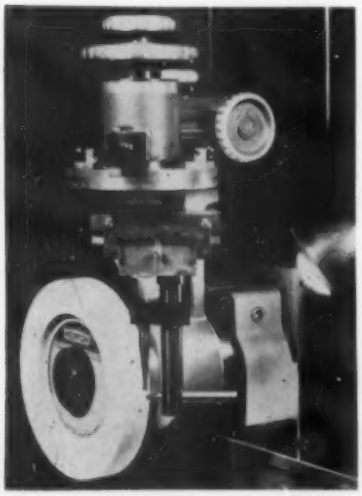
Index Table Has Slow Start, Stop

Slow starting and stopping is one feature of this indexing unit. With it, index time can be as brief as ⅛ sec with positive locking and without backlash. It is available with either a 10 or 18-inch-diam table. Power for the worm gear drive can be provided by a fractional horsepower electric, rotary air or hydraulic motor. The 10-inch-diam table will handle 200-lb loads with a ¼-hp motor whereas the 18-inch-diam table, with a ½-hp motor, can handle 400-lb loads. The 10-inch model can have as many as 16 stations; the 18-inch, 36.

Jackson Fluid Power Co., 16722 E. Warren, Detroit, Mich. **Circle 406**

Wheel Dresser Lessens Machine Downtime

Because it is mounted on the quill of a surface grinder instead of on the magnetic chuck, the Geometric-Surface wheel dresser saves wheel-dressing time. The workpiece does not have to be removed from the chuck to make room for the dresser. Model GS-1000 has a vertical mounting for small, concave surfaces and a horizontal mounting for all other wheel surfaces. It provides dimensional accuracy to 0.000025 inch and adjusts itself for diamond wear. It is capable of angular plunge forming from 0.010 to 0.375 inches in diameter, of both wet and dry wheel forming, and of recess or step forming. It is also adaptable to irregular template wheel forming across a 1½-inch wheel face. With each degree divided into minutes, angular face control is accurate.



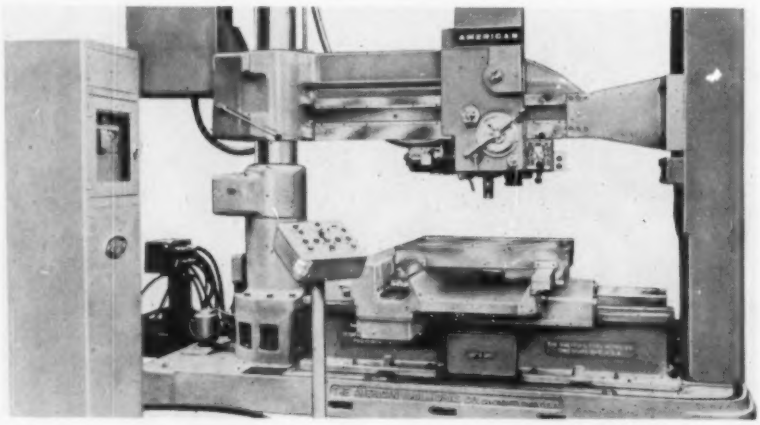
Crystal Lake Engineering Co., P. O. Box 98, Crystal Lake, Ill. **Circle 407**

Boring Bars Eliminate Chatter, Reduce Vibration

Five small boring bars make up Series BB-7500. These bars have the same diameters as the Series BB-7000 K-bars, but they have shorter lengths. They are intended primarily for jig boring machines and similar applications where rigidity is required for close tolerance boring with good finishes. The solid Kennametal shank, three times more rigid than steel, virtually eliminates chatter and reduces deflection and vibration. Positive rake triangular inserts of the screw-on type are used on the bars. Diameters for the series are ⅜, ½, ⅝, ¾ and 1 inch with respective lengths of 4, 5, 6, 7 and 9 inches.

Kennametal Inc., Lloyd Ave., Latrobe, Pa. **Circle 408**

Boring Machine Has Tape-Controlled Table

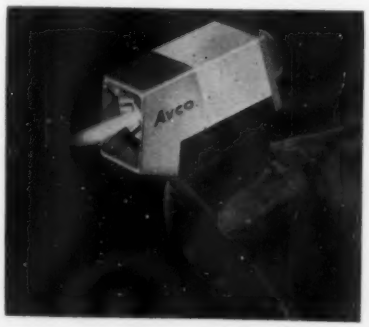


Shown here is an 11-inch-column boring, drilling, reaming and tapping machine combined with a numerically controlled positioning table. The machine has a tape-controlled automatic spindle cycle which, after the dials have been manually set, continues until a tool change is necessary. Spindle travel is 12 inches and the maximum distance between the spindle and table top is 37¾ inches. The spindle has 12 speeds in three different ranges of 30 to 1500 rpm, 45 to 2250 rpm and 60 to 3000 rpm. The main drive motor is 7½ hp. The table travels 30 inches on each axis. It has a positioning accuracy of ±0.00025 inch with repeatability of 0.000050 inch. It is controlled numerically and positioned hydraulically.

American Tool Works Co., Pearl at Eggleston Ave., Cincinnati 2, Ohio. **Circle 409**

Plasma Gun Sprays Fine Powders

Measuring 5 inches in length and weighing 3½ lb, the PG-100 Plasma Gun is well-suited for production-line work. It will spray coatings, including refractories, with controlled thickness, density and bond strength. It can be used also to fabricate free-standing forms. It has integral adjustable cathode control. A vernier control regulates powder feed. The housing of the



gun acts as a glare shield, heat shield and water-cooling jacket. The lightweight anodized aluminum gun head gives good thermal conduction and high external electrical insulation. Powders that previously were too fine for plasma guns can be sprayed with this unit.

Avco Corp., 201 Lowell St., Wilmington, Mass. **Circle 410**

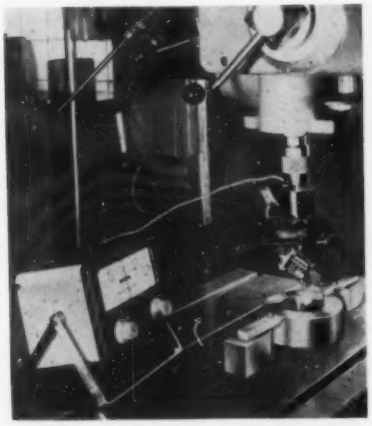
Electronic Control Stops Machine Damage

Automatic machine operations can be checked and controlled with the fully transistorized pulse logic monitoring device called Sensomatic Model 1200. It stops a machine immediately upon detecting any malfunction and pinpoints the source of trouble. It has no moving parts and its circuitry is encapsulated in epoxy resin for maximum resistance to shock and moisture. The device will monitor machine operations with as many as 12 stations.

Weldotron Corp., 907 Frelinghuysen Ave., Newark 14, N.J. **Circle 411**

Electronic Gage Centers Workpieces

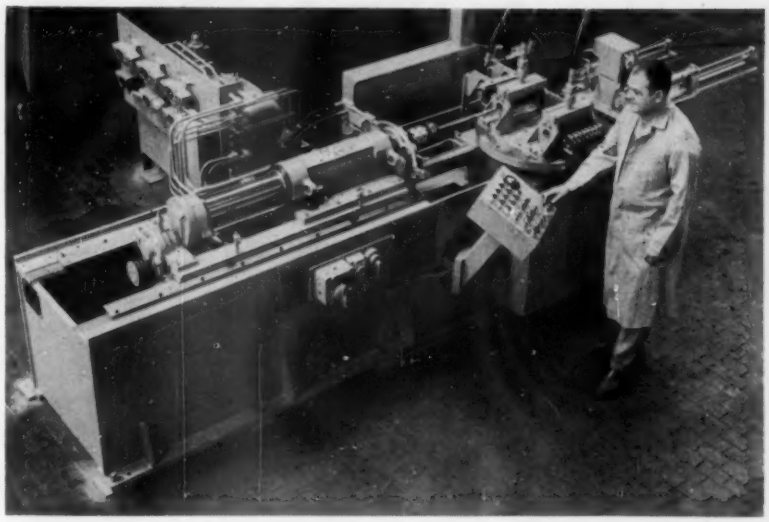
With this electronic gage, holes or cylindrical forms can be accurately centered under machine spindles. It can be used also to check spindle runout, taper, bellmouth, squareness, roundness and concentricity. Several magnifications are available, the highest being 5500:1 with 0.000020-inch graduations. It has a three-scale meter. A rotary



connector, which is adjustable to accommodate radii up to 9½ inches, allows the gage head to rotate freely with the spindle. Gaging pressure of less than 2½*g* eliminates deflection of the spindle. The amplifier is transistorized and battery-powered for greater reliability and instant operation.

Federal Products Corp., Providence 1, R. I. **Circle 412**

Horizontal Honing Ups Accuracy



Parts finished on this machine are stacked horizontally and microhoned as one long part. The machine—Model 5HXH-16—is especially suited for finishing parts such as connecting rods and gears which have short bore lengths compared to the bore diameter. Advantages of the method over setups involving four or six-spindle vertical machines include higher production rates, greater reliability since only one spindle is needed and added abrasive economy since longer stones are used. An automatic hydraulic probe prechecks the bore holes for proper clearance, thereby eliminating tool breakage.

Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich. **Circle 413**

Unit Supplies Coolant To Machine Tools

Available with either a 16 or 32-gal capacity, this tank and pump unit for supplying coolant to machine tools has two baffles to aid in settling chips and sludge. The ⅛-hp centrifugal pump circulates water soluble coolant or cutting oil up to 300 ssu viscosity. Volumes of 20 gpm at 7-ft head or 10 gpm at 14-ft head are available from this pump unit.

Brown & Sharpe Mfg. Co., Providence, R. I. **Circle 414**

Combination NC System, Machine Automates Milling

Shown here is a Bridgeport machine combined with a Hillyer numerical control system to make an automatic milling, drilling and boring machine for use in small shops. The machine—Model HB-20A—has a semiautomatic milling cycle and positioning through a 9 x 19-inch range. Numerical information is fed into it by either dial or punched tape. Leadscrews for both X and Y coordinates are ground to an accuracy of 0.0005 inch per foot of length. Backlash is automatically eliminated by always approaching the

final position from the same direction. The spindle operates at speeds from 80 to 2720 rpm with a stroke length of 5 inches. Drilling capacity is ⅜ inch in mild steel. The machine uses a 220-volt, 60-cycle, 3-phase power supply.

Hillyer Corp., 244 Sheffield St., Mountainside, N. J. **Circle 415**

Small Tapping Unit For Special Machines

Shown here is the Model 114 automatic tapping unit using a reversing attachment. It has free axial motion to

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Pressure-positive De-Sta-Co Clamp provides stability while lenses are cemented to light housings.

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Whatever needs to be held securely—by forces of fractions of pounds or multiple of tons—you can have absolute control with a De-Sta-Co clamp. Miniature models are available for extra light jobs—rugged, hefty models for heavy duty jobs—plunger action models for push or pull jobs—air-hydraulic operated models for multiple, split-second remote control operation. Select the model to fit the job, controlled holding power is yours, with De-Sta-Co.

De-Sta-Co Toggle Action Clamps quickly and accurately position ribs of an aircraft fuselage while skin is applied.

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permit the tap to follow its own lead and adjustable torque control to prevent tap breakage. Its capacity range is from No. 4-40 through No. 10. An electric motor drives the spindle with an air cylinder for the feed. A single direction motor is used with the reversing attachment. Tap speed range of the unit is 750 to 3000 rpm in seven steps.

Electro-Mechano Co., 241 E. Erie St., Milwaukee, Wis. **Circle 416**

Magnifier Speeds Miniature Parts Assembly

Because it magnifies objects on a flat field without curves, barreling, pincushioning or distortions of any kind, the Macroscope is well-suited for use when assembling and viewing miniature parts. Color transmission is true and clear without edge fringes or unnatural renditions. An achromatic magnification multiplier provides four specific stages of magnification. It swings into position to double a 2.5X system to 5X and a 3.5X system to 7X. Shadowless lighting is provided by a 22-watt, circular cold light fluorescent lamp. The lamp housing lens support can be raised and lowered and tilted front-to-back and side-to-side.

EdnaLite Research Corp., 222 N. Water St., Peekskill, N. Y. **Circle 417**

OBI Presses Have 40 to 200-Ton Capacities

Standard models of this OBI press are single geared and flywheel type, but the machine can be built with double back gearing. The capacity of these three presses ranges from 40 to 200 tons. They are used for such operations

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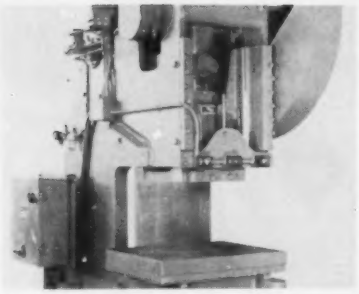

as blanking, forming, bending and shallow draw work. Their gap type frame gives unobstructed access to the die area from three sides. Finished parts can be removed from the dies by gravity of an air jet and directed through an opening in the back of the press.

Federal Warco Div., McKay Machine Co., Warren, Ohio. **Circle 418**

Press Brake Gage Is Air-Operated

Time-consuming hand measurements usually involved in aligning sheet metal for bending operations are eliminated with the air finger positioning gage. Pressure is applied to a foot pedal which releases air into a hose and then into the gage. As the air pressure activates the finger, the finger moves out,

indicating the correct placement of stock on the press brake. The movement of the finger can be adjusted to pinpoint accuracy. Air is exhausted through a valve upon release of the pedal. The bar of the gage fits all standard press brakes and remains locked in position during the operation.

Chrom-O-Lite Co., 2701 E. 78th St., Minneapolis, Minn. **Circle 419**

Small Parts Feeder For Assembly Work

By using a horizontal axis drum, the width of this small parts feeder has been held to a minimum. Model FE-101 is 6 inches wide and has a storage

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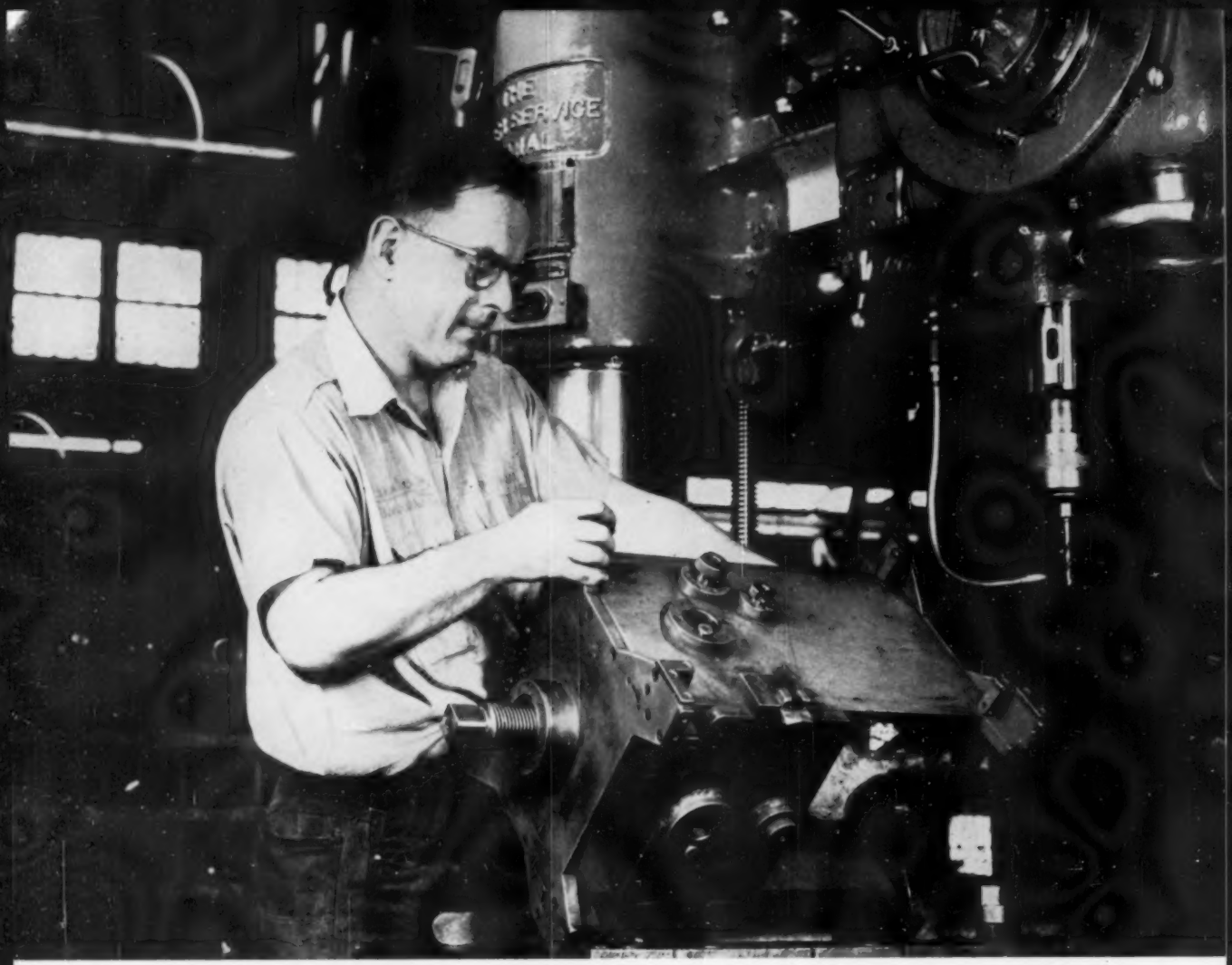

MAGNESIUM JIG CUTS COST OF DRILLING CASTINGS $3.08 PER UNIT!

By using magnesium tooling plate in place of steel, Worthington Corporation reduced the weight of tumble drill jigs from 125 pounds to 35 pounds. Used for close-tolerance drilling of castings, the magnesium jig can be turned by hand instead of by a chain hoist required for the heavier steel jig. This means a saving of $3.08 on every casting processed through the jig. And fabrication cost of the magnesium jig is 60% less than that of a steel jig.

Magnesium tooling plate can result in savings in your production operations. Its lightness, flatness, machinability and dimensional stability are ideal for fabricating accurate, easy-to-use jigs, fixtures, templates, gages, and for other tooling uses. For more information, write THE DOW METAL PRODUCTS COMPANY, Merchandising Dept. 1103FJ10, Midland, Michigan.

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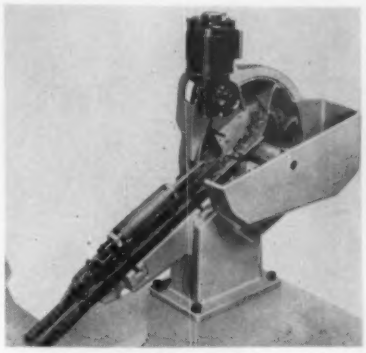


capacity of 150 cu in, while Model FE-104 is 10 inches wide and has a capacity of 700 cu in. Straight tracks provide optimum control of piece parts to the point of escapement, and Neoprene vanes on the inside of the drums provide gentle handling of parts in delivering them to the loading tray for entrance to the track. A divided track with adjustable width can be furnished for use with headed parts.

Dixon Automatic Tool, Inc., 2300 23rd Ave., Rockford, Ill. **Circle 420**

Sizing Device Controls Roundness

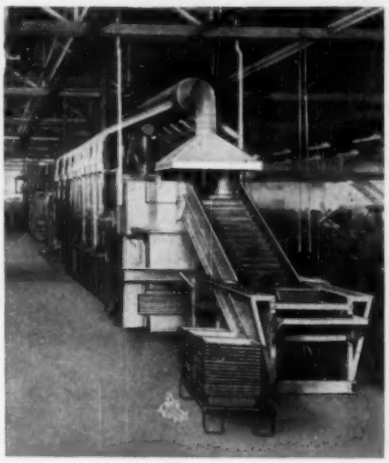
With the addition of a stroboscopic indicator, the L3-S Electro-Autosizer reads and controls roundness as well as size during grinding and turning operations. A neon light moving on a scale indicates the degree of roundness error. The shorter the line of light is, the smaller the error. The reading subdivisions can be calibrated as small as 0.000025 inch per division.

The gaging device also includes three machine control stages or feedback

lights which can be used to change speed of infeed; to stop and/or index the worktable; or to retract the wheelhead or tool. Each of the lights or actuation positions can be dialed electronically on setup knobs calibrated in terms of workpiece dimension and reading in divisions as fine as 0.00005 inch.

Electro-Autosizing Machine Corp., 7 William St., Closter, N. J. **Circle 421**

HOLCROFT



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Relieving Fixture Aids Tool Cutter Sharpening

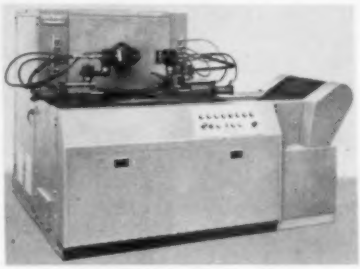
This two-way relieving fixture is used for radial relief, axial relief, any combination of radial and axial relief, and plain circle grinding. The Hybco fixture, available with swivel index base, rectangular base or extended base with outboard bearing and tailstock, can be motor or hand-operated.

Typical tools that can be sharpened are dovetail milling cutters, center drills, end-forming tools, center reamers, die sinking tools, step drills, subreamers and two-flute milling cutters.

Henry P. Boggis Co., 706 E. 163rd St., Cleveland 10, Ohio. **Circle 422**

Heating Machine Has Building Block Design

This flame heating machine combines a self-contained flame heating unit and a self-contained conveyor type quench tank. The heating unit—with its retractable, rotating work spindle and flame heads—controls fuel gas, oxygen, air, water and primary electric



power. Accessory equipment includes an electronic temperature control, a rotary flame head and various work-holding and automatic work-handling fixtures. The quench tank automatically circulates and agitates the quench medium. It also has a heat exchanger and a conveyor for the automatic removal of parts.

The Cincinnati Milling Machine Co., Meta-Dynamics Div., Cincinnati 9, Ohio. **Circle 423**

Hydraulic Power Package Improves Heat Dissipation

Available with tank sizes of 10, 20, 40 and 80 gal, this hydraulic power package includes an electric motor, various piston and vane pumps, a relief valve

Precision is the reason!

INTERCHANGEABILITY

OBERG CARBIDE DIES are made to exacting standards and feature guaranteed interchangeable components. This simply means that each and every Carbide Cut-Edge in an OBERG CARBIDE DIE or its replacement is made to fit perfectly. No need to special fit die parts if a part should break. Since detailed information is filed on every OBERG DIE in active service, a phone call generally starts the replacement detail on its way. Such interchangeability assures easier and less costly maintenance . . . standard results with all OBERG CARBIDE DIES, because. . . .

Oberg is something special

Oberg Manufacturing Co., INC.
FREEPORT, PA.

Send today for Bulletin 261. It describes Oberg Carbide Dies, plant facilities and services.

Use Reader Service Card, CIRCLE 86

and a reservoir. Motor sizes range to 40 hp and pump sizes to 60 gpm. Internal baffling provides a long return path which improves heat dissipation and purges the oil of any trapped air. The T-series power packages have a second air breather which prevents blow-back when filling.

Vickers Inc., Detroit 32, Mich.
Circle 424

Vibratory Finisher Is Completely Automatic

Continuous, high-production finishing of metal, plastic or ceramic parts is possible with this fully automatic continuous process vibratory gyrator. Work can be fed or conveyed automatically into and out of the machine.

Media are automatically cleaned, screened and recirculated. Compound and water are also added automatically.

Pangborn Corp., Hagerstown, Md.
Circle 425

Induction Heater Has Dual Stations

This machine—the 5-kw RF Inductron—is a bench type induction heating machine for hardening, annealing, drawing, normalizing, stress-relieving, soldering, brazing and shrink-fitting on either a small-lot or high-production basis. Self-contained, compact and easy

McCROSKY
Wizard®
QUICK-CHANGE
CHUCKS and COLLETS
increase production and cut costs.

● The collet is inserted into the revolving chuck—centered automatically—and locked rigidly in position. A slight pressure on the chuck collar releases the collet for tool changes without stopping the machine spindle, increasing production and cutting costs.

Send for Bulletin No. 20-C Today. It gives full details.

McCROSKY TOOL CORPORATION
MEADVILLE, PA.
COST CUTTING TOOLS
Engineering and Sales Representatives in the Principal Cities
Use Reader Service Card, CIRCLE 87

ALINA
SERIES "W"
BORE GAGES
Range from .150" to 12"

Alina bore gages are extremely sensitive and designed for trouble-free operation.
The three point centralization system locates the gage in the hole quickly and accurately.
Alina bore gages will swiftly reveal taper, bell mouth, out of round, and other dimensional variations.
A push-button retracts the movable anvil for easy non-scratching insertion into the workpiece. This feature also saves wear on the anvils.
Each gage is equipped with tungsten carbide contact points for lasting on the job accuracy.
Bore gages with measuring depths up to 80" delivered on special order.
Model WO-1 available with measuring heads down to .150".
Furnished as a set complete with depth adjustment stops (except for sets WO-6, WO-8 and fitted wooden case.

ALINA WRITE FOR ILLUSTRATED LITERATURE
ALINA CORPORATION
122 East Second Street, Mineola, Long Island, New York
Use Reader Service Card, CIRCLE 88

to move, it can be used in production lines to reduce work handling. Dual heating stations and an independent electronic control permit different heat levels to be employed at each station.

Another model, the 1-kw Inductron, is useful in the manufacture and assembly of electronic components, small instruments and jewelry, and for research laboratory work. It heat-treats, anneals, normalizes, solders and brazes. Operating at 450 kc, it provides scale-free heating, with thin cases, narrow transition zones, and minimum distortion.

The Cincinnati Milling Machine Co., Meta-Dynamics Div., Cincinnati 9, Ohio. **Circle 426**

Three Dial Indicators Have High Accuracy

Two dial indicators—one balanced and the other continuous—have AGD accuracy of ±0.00005 inch for their 2½-turn, 0.015-inch total range. The dial of the balanced model, No. 25-109,

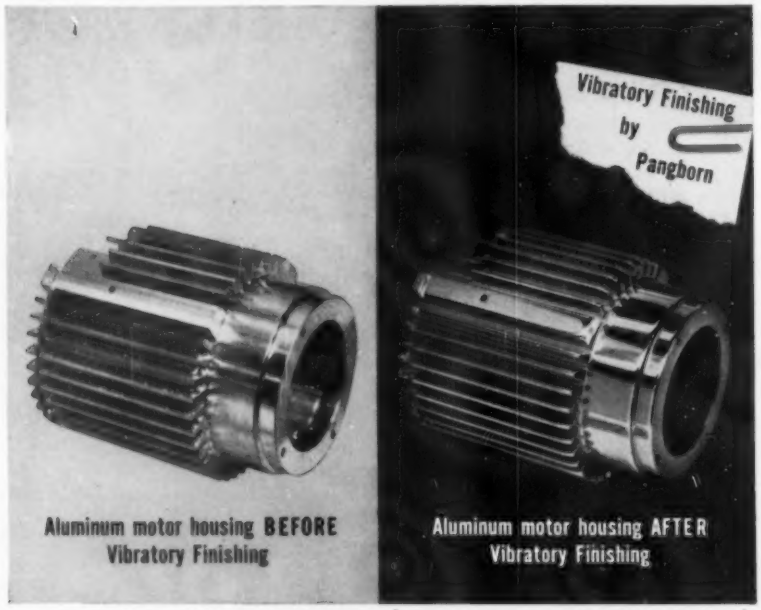
reads 0-3-0, while the dial of the continuous model, No. 25-209, reads 0-6. Both are graduated in 0.00005-inch increments.

Another balanced dial indicator, No. 25-106, has graduations read in 0.00005-inch increments and a dial reading of 0.0015-0-0.0015. Total range is 0.003 inch. This model is accurate to ±0.00001 inch and is particularly suited for shop inspection to laboratory standards or in laboratory work. All three models have jeweled bearings.

The L. S. Starrett Co., Athol, Mass. **Circle 427**

Optical Tool Checks Alignment, Angularity

Checking alignment and angular spacing of rotating parts such as machine tool indexing tables can be done with the Milichex Model MOX-3600 optical tool. When used with an autocollimator or similar optical sighting device, this 360-sided optical polygon provides a mirror surface which reflects the projected image of the sighting device's cross hairs. The amount of deviation between the reflected image and the graduated cross hairs in the sighting device gives a geometric check on misalignment, parallelism and angularity. In operation, the instrument is placed at the center of the rotating



Amazing, how inexpensive complex finishing can be!

In some cases, the Pangborn Vibratory Finishing Machine has reduced finishing time by over 90%. You know what this means in time and labor savings alone. Especially since this machine tackles complex finishing assignments with the same ease and speed as simple ones.

Its uses are amazing, too. It descales, deburrs, burnishes, radiuses, fine-finishes. It handles a wide variety of materials . . . metals, plastics and ceramics. And this machine tackles complex and difficult jobs impossible or impractical to do by other methods . . . and does them quickly and economically.

The exclusive air-cushioning system built into every Pangborn Vibratory Finishing Machine provides better and closer amplitude control and offers automatic adjustment for any weight load. Air-cushioned floor mounts eliminate any transmitted vibration. No special foundations are necessary. Variable speed controls available on all models. Automated and auxiliary equipment, media, compounds for every need. Send parts with exact finish specifications or finished specimen for sample processing in our laboratory to Mr. William Brandt at:

PANGBORN CORPORATION, 4700 Pangborn Blvd., Hagerstown, Md., Pangborn Canada, Ltd., 47 Shaft Rd., Toronto (Rexdale), Canada—*Manufacturers of Vibratory Finishing, Blast Cleaning, Dust and Fume Control Equipment; Rotoblast® Steel Shot and Grit®.*

Pangborn
OF HAGERSTOWN

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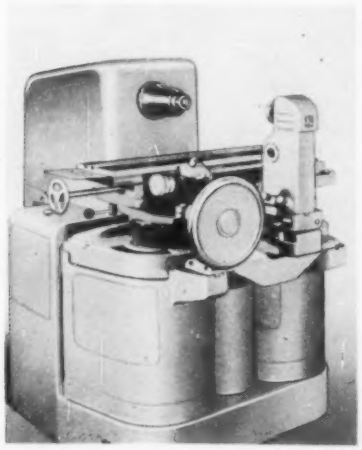
device. It is then oriented into coincidence with the autocollimator to establish the initial zero position of mirror to collimator.. The unlocking knob is turned and the polygon is rotated and locked. The part to be checked is rotated the same number of degrees in the opposite direction. The error in augularity with respect to the initial position is viewed through the autocollimator. Accuracy of the optical instrument is within ¼ sec of arc or 0.000012 inch at a 20-inch diameter.

Michigan Tool Co., 7171 E. McNichols, Detroit, Mich. **Circle 428**

Two Comparators Give Direct Projections

Measuring capacity of the Model DPC-ER direct projection comparator is 8 inches vertically and 10 inches horizontally. Whereas it has double column support, its companion has



single column support. Model DPC has a measuring capacity of 4 inches vertically and either 5 or 8 inches horizontally. Both models give coverage up to 60-inch screen size at all magnifications from 5X to 100X. They are used in a dark or semidark room. Shadow images can be viewed on any suitable flat surface.

Jones & Lamson Machine Co., Springfield, Vt. **Circle 429**

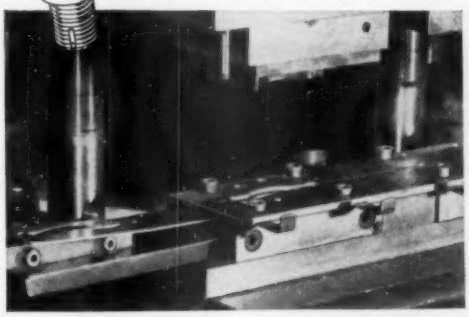
Multitube Furnace Has Detachable Pusher

This four-tube diffusion furnace reaches a maximum temperature of 1300 C in its 36-inch-long heating chamber with a rated uniformity of 18 inches plus or minus 1.0 deg Cent. Each of its two zones of control has

2 more case-histories prove:

Shock and Vibration Can't Loosen These P-K® SOCKET SCREWS with LONG-LOK

The precision originally built into machines is often at the mercy of the socket screws that are used to maintain alignment, tolerances and security. Pounding and vibration can make a lot of socket screws loosen, but P-K Socket Screws with Long-Lok Inserts ask for more. For instance:



On big metal stamping presses in a container manufacturer's plant, conventional screws were loosening, spoiling stampings and damaging tools. When P-K Shoulder Screws **with Long-Lok Inserts** replaced "Brand X"... trouble stopped. The canmaker switched to P-K's on **all** machines. Three months later, P-K Screws were actually tighter than when first installed!

On inserted-tooth milling-cutters, blades must be held tightly for precision cutting. But, since blades must be removable for sharpening (perhaps 40 times or more in their lifetime), they must come out easily, too. Designer of the milling cutter shown, found P-K Socket Set Screws met both requirements...and at lower **In-Place** cost, too!

Full technical details and FREE test samples, on request.

It's in the groove...

Secret of Long-Lok's grip—and its high reusability—is the **greater length** of the Polycap (nylon-type) insert. It provides **minimum five-thread** engagement (except in the shorter sizes), is available even longer on special order. Long-Lok Inserts eliminate lock washers or safety wires...can be supplied with **any type or size** of P-K Socket Screws. Stainless steel and copper Long-Lok Inserts also available for special environmental conditions.

minimum 5 thread engagement

LONG-LOK more length for more grip

Full line...fast service...qualified technical help
There's a P-K Socket Screw for every purpose—available through your nearby P-K Distributor. Call on him on for quick delivery and fastener ideas that save you money.

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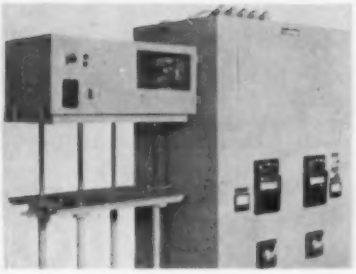


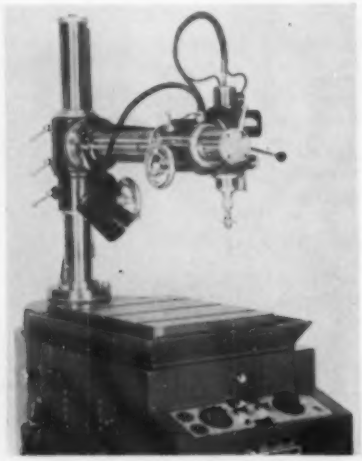
12 globars, a 9.0-kva tapped element transformer, a platinum 13 percent rhodium controlling thermocouple and a proportioning controller to indicate and control the temperature. The furnace has a detachable pusher mechanism with a soak timer adjustable to 30 hrs and a variable speed control. It accommodates four separate pusher arms having a travel distance of 34 inches each. The arms are coupled to quartz rods linked to work boats. All boats return to original position after the preset time has elapsed.

Lindberg Engineering Co., 2450 W. Hubbard, Chicago, Ill. **Circle 430**

USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Metal Disintegrator Cuts Hard, Soft Metals

Hard and soft metals, tools and dies can be cut with the portable C-86 metal disintegrator. It arc-drills shaped holes in hardened steels, titanium, Inconel and other difficult-to-machine metals. It is particularly valuable as a tap remover. Taps and studs from the smallest size of No. 00 on up can be removed. Fluted tools such as drills and reamers from 0.012 inch on up can be extracted.

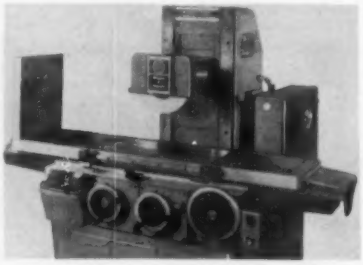


The machine has a T-slotted table which can support a 5000-lb load. It also has three full 360-deg setups in one superstructure—vertical mast, horizontal ram and cutting head. Input power to the machine is 220 and 440 volts, a-c, single-phase, 50-60 cycle.

Cammann Manufacturing Co., Inc., 2700 Henninger Rd., Cleveland 9, Ohio. **Circle 431**

Surface Grinder Has Fixed V, Flat Ways

This machine can perform highly accurate die grinding and is well-suited for general production work. Fully automatic operation is made possible by the addition of an automatic slot and surface grinding attachment, a wet grinding attachment and a vertical posi-



tion indicator attachment. The machine has a permanently lubricated spindle, powered by a 5-hp direct-drive motor. The spindle is flange-mounted, allowing extremely accurate slot or shoulder grinding. The spindle upright moves on its own V and flat way transversely, while the table is also mounted on a separate V and flat way for longitudinal movement. The machine has rapid positioning, both horizontally and vertically at 50 ipm; automatic truing speed of 10 ipm in either direction; and infinitely variable table speeds from zero to 125 fpm.

Brown & Sharpe Mfg. Co., Providence 1, R. I. **Circle 432**

Hydraulic Tool Sets Tube Fitting Ferrules

Ferrules on flareless tubes of steel, stainless steel and monel can be preset with the Hy-fer-set. This tool accommodates dies for tubes with outside diameters ranging from ¼ to 2 inches. The tube—with the nut slipped over it and with the ferrule in position—is clamped in the dies. The ferrule is wedged onto the tube with the nut slipped over it and with the ferrule in position—is clamped in the dies. The ferrule is wedged onto the tube with the tool, producing a "bite." The tool is portable and is operated hydraulically by a hand pump. A gage on the pump enables the operator to determine the pressure required to adequately bite a specific material and wall thickness.

Parker-Hannifin Co., 1725 Euclid Ave., Cleveland 12, Ohio. **Circle 433**

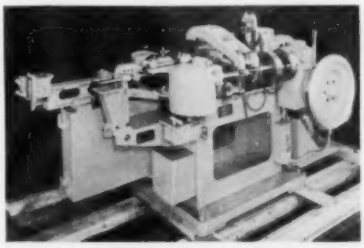
Knuckle Joint Press for Short Stroke Work

This press is one of several single back geared knuckle joint presses ranging in size from 100 to 2500 tons. It is used on short stroke work where heavy bottoming pressure is required or where a slight dwell at the bottom of the stroke is required to allow metal to fill out the die. Typical operations performed by it are coining, extruding, cold forming, sizing, swaging, heading and embossing. Materials to be fed to the press can be handled either manually or automatically. The press has a pneumatic friction clutch and brake unit.

Federal Warco Div., McKay Machine Co., Warren, Ohio. **Circle 434**

Multislide Machine Has Symmetrical Design

Outputs of 400 strokes per minute are attainable with the Model MS-28-HS multislide machine for making formed stampings. Its die heads are reversible and can be used from either the front or the back. This feature gives versatility both in operation and in designing tools. The machine has a 5-hp variable speed drive. Its length of



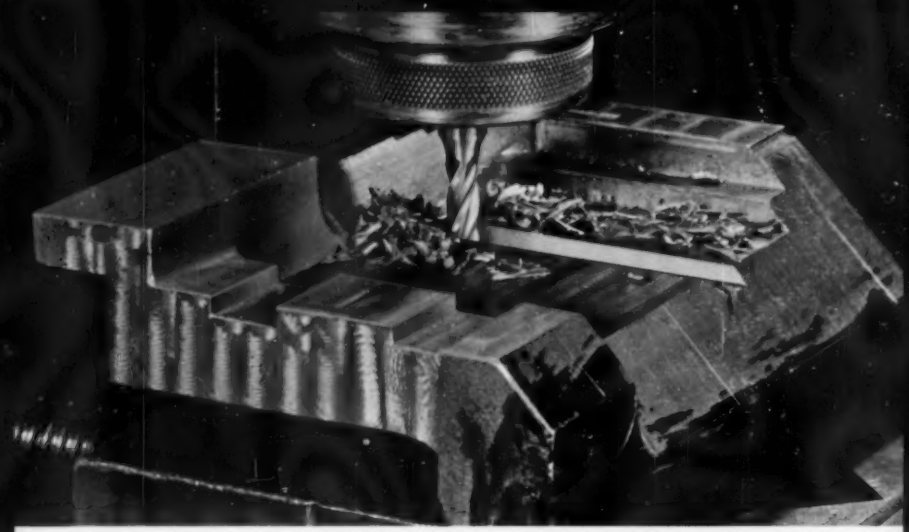
feed is 8 inches. Maximum width of stock that it can accommodate is 1½ inches, maximum thickness 1/16 inch.

U. S. Tool Co., Inc., Ampere (East Orange), N. J. **Circle 435**

Hollow Aluminum Stock For Screw Machines

Reduced material costs, less scrap and fewer chips are three advantages of using hollow aluminum screw machine stock and/or mechanical tube. Use of either stock eliminates drilling and boring and, since less heat is generated, minimizes the cooling needed to prevent thermal expansion. The screw machine stock is available in various alloys with outside diameter

The story behind the chips



Savings In Time—Lower Tool Costs—Finer Finishes—More Accurate Cuts

Many types and sizes of *standard* Putnam End Mills are considered as "specials" by other manufacturers. Thus, Putnam customers get off-the-shelf deliveries that get their end mills on the job faster and at lower cost than "specials."

On the job, Putnam End Mills again save time and money. Designed for fast, free-cutting action, these end mills have extra long life. They will stand up when operated at high speeds and heavy feeds—on the toughest metals they really "hog-in" to quickly remove stock.

For applications requiring accurate cuts, Putnam's attention to manufacturing details and rigid quality control assures complete uniformity in each end mill. Also, users often find the exceptionally fine finishes obtainable with Putnam End Mills eliminate the need for grinding or hand finishing.

A pile of chips—the milling job is completed. But, for users of Putnam End Mills, there is always a story of unusual savings and benefits behind that pile of chips.

PUTNAM
TOOL COMPANY
2981 CHARLEVOIX AVE. • DETROIT 7, MICHIGAN

MILLING ALUMINUM – Putnam has a complete line of *standard* end mills that are specifically designed for efficient milling of aluminum and aluminum alloys.

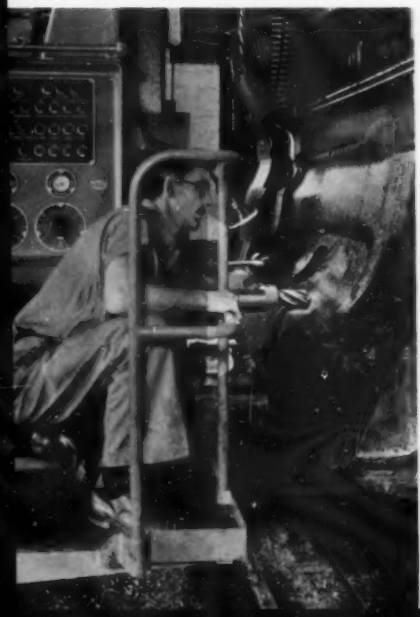
Over 1800 Standard Types & Sizes of Putnam End Mills

Now you can order standard end mills ranging in diameter from 1/32″ to 6″ and get off-the-shelf delivery. In the Putnam line of over 1800 standard types and sizes are many end mills that are considered as "specials" by other manufacturers.

For example, in the MITEE-MITE series of standard end mills, diameters as small as 1/32″ are available. Thus, your milling, profiling, routing or engraving jobs in small or hard-to-get-at areas can now be done without special tooling.

Regardless of your requirements, there probably is a Putnam standard end mill that will exactly meet your needs. You can get all the superior Putnam cutting qualities for milling: intricate shapes, deep cuts, tough materials, aluminum, etc. – without purchasing costly specials.

Contact your local Putnam Distributor, he will recommend the best end mill for each specific job and give you quick delivery from his stock.



ON THE BIG JOBS—Putnam Postiv-Lok will cut your costs over 25% on end mills 1½″ in diameter and larger. Quick delivery from stock on diameters to 3″.

A plant that specializes in the manufacture of end mills

Putnam end mills are made by specialists who work in a modern plant having the finest equipment available. Every end mill is machined from high speed steels of rigid Putnam analysis, heat-treated in our own plant and produced under close quality control. Because *end mills are our business,* we carefully guard their reputation for quality and performance with individual inspection on a score of important details.

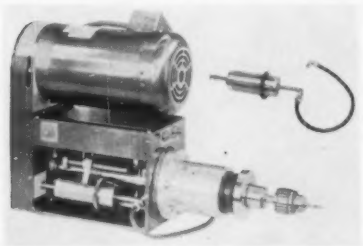
DISTRIBUTORS
IN CITIES
COAST TO COAST

sizes from 1 to 4 inches and wall thicknesses from 3/16 to 1/2 inch. The tube, for general machining operations at lower speeds than those characteristic of automatic screw machines, is also available in various alloys. Its 47 outside diameter sizes range from 1 1/4 to 12 inches and 11 wall thicknesses from 1/8 to 1 inch.

Aluminum Company of America, 725 Alcoa Bldg., Pittsburgh, Pa. **Circle 436**

Drill and Tap Control Eliminates Tool Breakage

Designed for use with portable drilling units, this control permits drilling and tapping in one operation. During the drilling portion of the stroke, the drill and tap control is idle to provide maximum allowable thrust for rapid metal removal. As the threaded section of the tool engages the work, the control cancels out a predetermined portion of the advance pressure, producing a light, tapping thrust that allows the tool

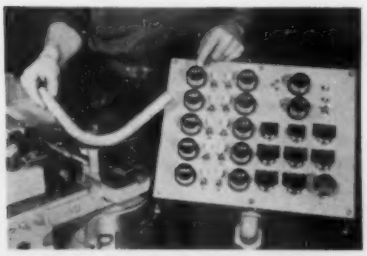


to feed itself into the work without excessive tool or material stresses. It facilitates rapid changes in tool sizes or material and, once adjusted, provides uniform thrusts in cycle after cycle, eliminating tool breakage. Intended for use with the Dumore Series 28 Drill-N-Tap portable drilling units, it is available in two models. One is for single tool use and the other, for use with multiple-spindle attachments.

Dumore Co., 1300 Seventeenth St., Racine, Wis. **Circle 437**

Angle Selector Programs Bending

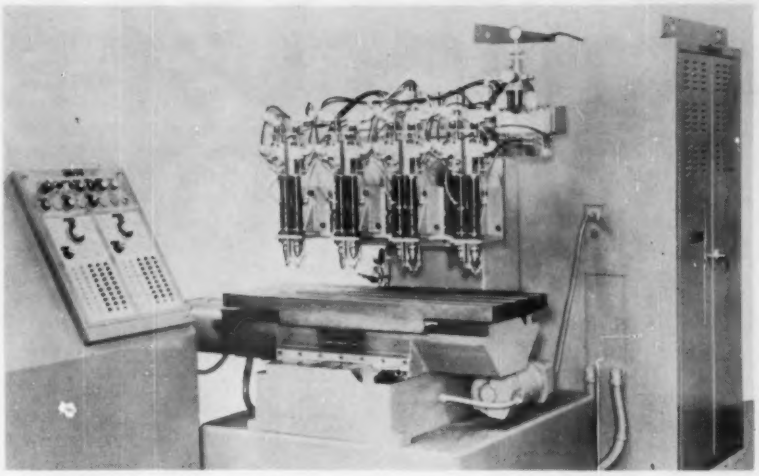
As many as 10 successive bend angles can be dialed on the electronic angle-of-bend selector illustrated. This unit can be programmed from blueprints or



from records of previous setups. The Dial-A-Bend operates on the principle of matching electrical impulses from signal potentiometers. When the swinging arm rotates to the proper angle, the control matches the angle setting and the bending arm is stopped, terminating the bend. Each dial has three digits graduated to tenths of a degree. Two compensator dials are included for correcting springback and other factors influencing the angle bend.

Pines Engineering Co., 601 Walnut St., Aurora, Ill. **Circle 438**

NC Machine Has Four Drilling Clusters



Printed circuit boards of a wide variety of materials and thicknesses can be drilled with the numerically controlled Model NPB drilling machine. It consists of a tape-controlled point positioning table and four drilling clusters. Each drilling cluster has four independent air feed drill units which can be fitted with different size drills and rotated at different speeds up to 22,000 rpm. Under average conditions, the machine operates at 50 cpm and drills four boards at once. The table has a travel of 14 x 20 inches at 200 ipm and a flat working surface measuring 18 x 44 inches. It has a 2-inch zero offset in each axis, allowing the table movement needed for changing to different drill sizes. A backlash settling device provides table positioning.

Edlund Machinery Co., Cortland, N. Y. **Circle 439**

USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Vibratory Finisher Has High Shaking Force

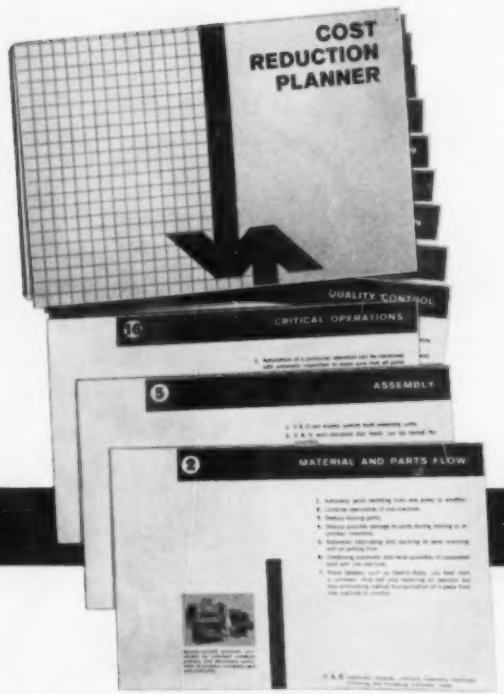
Using a resonant electromagnetic system, this 6-cu-ft-capacity vibratory finishing machine gives shaking forces up to 50 G. It has only one moving part, the tub. Shaking force is set by a knob from zero to 5/16-inch amplitude. The power supply is 220 volt, a-c, operating through three pairs of epoxy-compound impregnated and encapsulated magnets. The suspension is such that a continuous rotary turnover motion provides 100 percent scrubbing action between media and parts. The tub, which is 37 x 20 x 15 inches deep, holds a 750-lb charge. Model V-600 is used for deburring, radii-forming, descaling, flash removal, cleaning and polishing.

Vibrodyne Div., Globe Industries, Inc., 125 Sunrise Pl., Dayton 7, Ohio. **Circle 440**

Device Tests Nonferrous, Nonconductive Materials

In addition to gaging nonconductive coatings on nonferrous base metals such as aluminum and copper, this nondestructive testing device measures the thickness of a nonferrous metal on a nonferrous base, the thickness of a nonferrous coating on a nonconductor and the conductivity of a nonferrous metal. The Type EC Permascope operates on the eddy current test principle. However, the electronic circuitry of the in-

SOME CUES FOR THE ACTIVE COST-REDUCER



This PLANNER is for the man who doesn't have time to waste determining whether a supplier can help him produce at less cost. If you're this type of active cost-reducer, we know we're welcome. It takes only five minutes to go through this PLANNER and not much longer to get us started on any project it may suggest. Like to have our man in your area call? Please contact Emhart Manufacturing Company, Hudson Division, Hudson, N. Y.

EMHART

COST REDUCTION IN SMALL PARTS PRODUCTION

This is our business — and to prove it, we'd like to go over at least sixteen areas in which we've had good, hard practical experience. Here they are:

1. PRODUCT DESIGN
2. MATERIAL AND PARTS FLOW
3. PACKAGING
4. FABRICATION
5. ASSEMBLY
6. DIRECT LABOR
7. INDIRECT LABOR
8. METHODS SIMPLIFICATION (People)
9. METHODS SIMPLIFICATION (Machines)
10. QUALITY CONTROL
11. IN-PROCESS INVENTORY
12. MAINTENANCE
13. FLOOR SPACE
14. SPARE PARTS INVENTORY (Customer)
15. SPARE PARTS INVENTORY (V & O Machines)
16. CRITICAL OPERATIONS

V & O AUTOMATIC PRESSES AND FEEDS

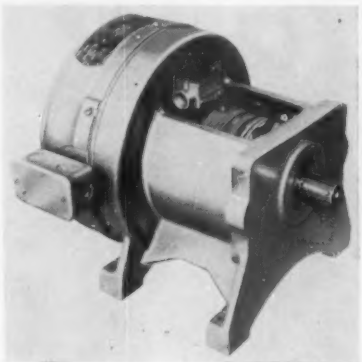
Use Reader Service Card, CIRCLE 97

strument allows compensation for conductivity variations of the base metal which would otherwise produce erroneous readings. Equipped with two direct reading scales, the device has thickness measurement ranges of 0-0.001 and 0-0.005 inch. Anodized aluminum plates and plastic foils in accurately determined thicknesses as well as a copper standard are furnished for calibrating the instrument.

Twin City Testing Corp., 533 S. Niagara, Tonawanda, N. Y. **Circle 441**

Machine Drive Gives Fast Stop-Start Cycles

Because the Vari-Power machine drive for start-stop cycling of production machinery and machine tools stores kinetic energy for meeting momentary peak load requirements up to 10 times their average load ratings, motor sizing can be based on average power requirements instead of peak load needs. The drive has an axial air gap motor and an integral clutch-brake coupling. Within the motor a high inertia, constantly spinning motor achieves a flywheel effect to store kinetic energy. When the clutch is engaged and the brake is released, the output shaft reaches top speed almost instantaneously. Models of the drive have ratings from ⅛ to 7½ hp and speeds from 1200 to 3600 rpm.



Ferguson Machine Co., 7818 Maplewood Industrial Ct., St. Louis 17, Mo. **Circle 442**

Power Unit Feeds to Positive Stop

Illustrated here is an electromechanical leadscrew power unit for drilling, boring, reaming, counterboring, spotfacing, chamfering, milling and trepanning. It has a recirculating ball type mechanism for feeding against a positive stop. Spindle drive, rapid traverse and feed are provided by sepa-

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ACTUAL SIZE

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- **Right or left hand cutting**
- **Ground all over for extremely fine dimensional control**

SPECIFICATIONS

SIZE	BODY DIA.	DRILL* DIA.	DRILL LENGTH	O.A.L.
1	1/8"	3/64"	5/64"	1¼"
0	1/8"	1/32"	1/16"	1¼"
00	5/64"	.025"	3/64"	7/8"
000	1/16"	.016"	.030"	7/8"

60° included angle standard.
*Specials as small as .005" are available.

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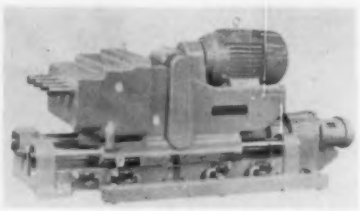
TOOLS of today



rate motors. The rapid-traverse motor drives the leadscrew and the feed motor drives the recirculating ball nut. The adjustable torque brake, which permits feeding against a positive stop, can be calibrated to slip at a preset overload. Standard rapid-traverse rate is 280 ipm.

Foote-Burt Co., 13000 St. Clair Ave., Cleveland 8, Ohio. **Circle 443**

Hydraulic Cylinder Automates Manual Operations

Precise programming and automatic repetition of variable-speed and length-stroke operations are possible with the Series 80 electrohydraulic cylinder. When led through any series of strokes required to perform a given operation, the cylinder develops proportional electrical signals which are in turn recorded

on a position indicating instrument. The cylinder will then duplicate the operation on command. The cylinder is normally used in closed loop hydraulic circuits using servovalves. The signal developing transducer mounted integrally within the cylinder is pressure balanced and is not affected by cylinder rotation or axis orientation. A constant feedback signal from the transducer prevents overshoot and hunting. The cylinder can be mounted singly or compounded to obtain any desired work position. It can be used for automating repetitive manual operations such as press feeding, indexing, assembly, ma-

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chine tool actuation and tracing. The output signal can be used also for controlling remotely installed cylinders.

Guerin Engineering, Inc., 23255 Woodward Ave., Ferndale 20, Mich. **Circle 444**

Spring Plungers for Jigs and Fixtures

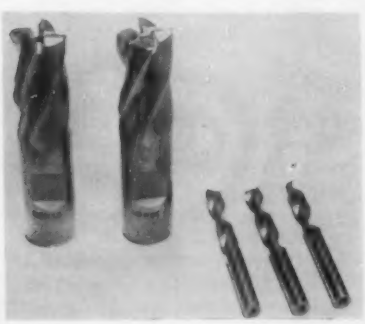
Used in positioning parts in jigs and fixtures, these spring plungers withstand continuous flexing without crystallization. The spring, when compressed, allows the plunger to recede entirely into the threaded body. A set-

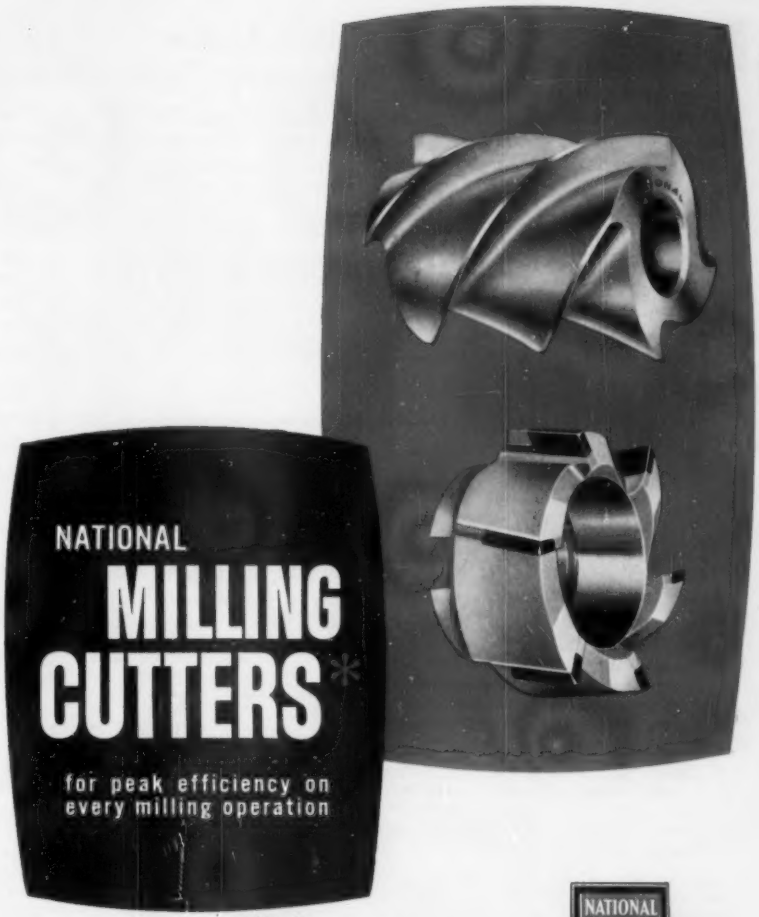
screw, backing up the spring, is preset and locked for uniform pressure. The steel plunger tips can be ground to meet specific needs. They will not spread. Both the silver nose, cadmium-plated model for applications with mild and pressure and the heavy-duty type model range in size from 9/32 to 1 inch.

Jergens Tool Specialty Co., 712 E. 163rd, Cleveland, Ohio. **Circle 445**

Machinable Carbide for Cutting Tool Blanks

Drills and end mills, such as those illustrated, can be produced out of a machinable carbide called Ferro-Tic J. In the annealed, as-received state, this fully sintered composite of carbide particles dispersed in a high-speed steel matrix can be turned, drilled, milled, tapped or filed. Once heat-treated to Rc 70, however, the tool blank behaves like a solid carbide. As an insert, it





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Your National Distributor, backed by the most competent engineering staff and the best testing facilities in the industry, has a truly complete line from which to select and recommend the *right* cutter for your specific needs.

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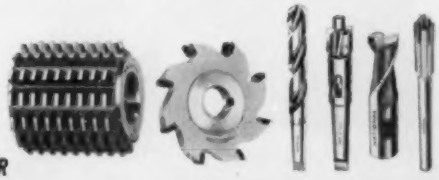

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can be used to cut ferrous alloys as well as a wide range of nonferrous and nonmettalic materials. Cutting speeds of 100 to 200 fpm on semihard alloys are possible without damaging the tool.

Sintercast Div., Chromalloy Corp., 171 Western Hwy., West Nyack, N. Y. **Circle 446**

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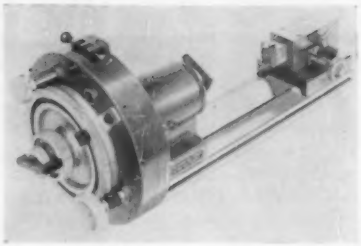
Unit Assures Accurate Center Work

Finer tolerances in inspection of work on centers, and in jig boring, milling and jig grinding work on centers are assured with this index center. It also achieves high precision on form grinding of spiders, splined punches, gear die punches and dies, and sectional parts of dies where revolving the part on centers or in a spindle is necessary. Its spindle contains 192 balls having a tolerance of ±0.000005 inch under load.

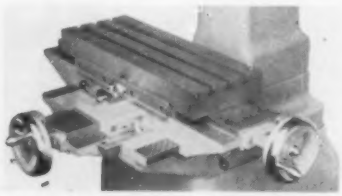


It runs true to 0.000015 inch TIR. The unit also has a lapped carbide index plug and four lapped-fit carbide plug-in stations. The extra plug-in station allows turning the work piece 180 deg at any time to center the work. It can also be used to reorient for a different set of angles on the same workpiece.

Moore Special Tool Co., Inc., Bridgeport 7, Conn. **Circle 447**

Improved Jig Borer Has No Overhang

Increased size of table and saddle assembly is one feature of the Model 1A jig boring machine. The table bearing area has been increased over 400 percent and the saddle bearing area has been more than doubled. Square edged ways, positive no-shift table and saddle locks, ⅜-inch table T-slots, in-



dividual gib adjustment with self-locking type inserts are among its other features. Reference scales with movable pointers allow positioning without counting handwheel turns. Table size and movement are 7 x 17½ and 6½ x 10 inches, respectively. The spindle operates at speeds from 275 to 4250 rpm.

Linley Brothers Co., 682 State St., Bridgeport 1, Conn. **Circle 448**

Machine Doubles as Surface, Profile Grinder

This Maegerle grinding machine combines the features of both surface and profile grinders. It has two fully automatic and interchangeable wheel dressers—a hydraulically operated diamond dresser for flat or slightly irregular surfaces and a crush-dresser with profile roller that automatically cycles its full dressing sequence. Both are interconnected with two additional automatic features. One of these adjusts the wheel speed to the diminishing

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Our inspection projector magnifies cutting edges to eliminate the minute angular deflection that could cause you costly production losses . . . just one of many inspections that account for Circle R quality.

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DETROIT — J. L. Bickford Associates
HACKENSACK — The Eaton Company
INDIANAPOLIS — Donald McIntire
MEMPHIS — Branch-Marvin Tool Specialties
MILWAUKEE — Ford Tool Company
MONTREAL — Humphrey E. Walton
NEW HYDE PARK — The Eaton Company
NEW YORK CITY — J. V. Granozio (Export)
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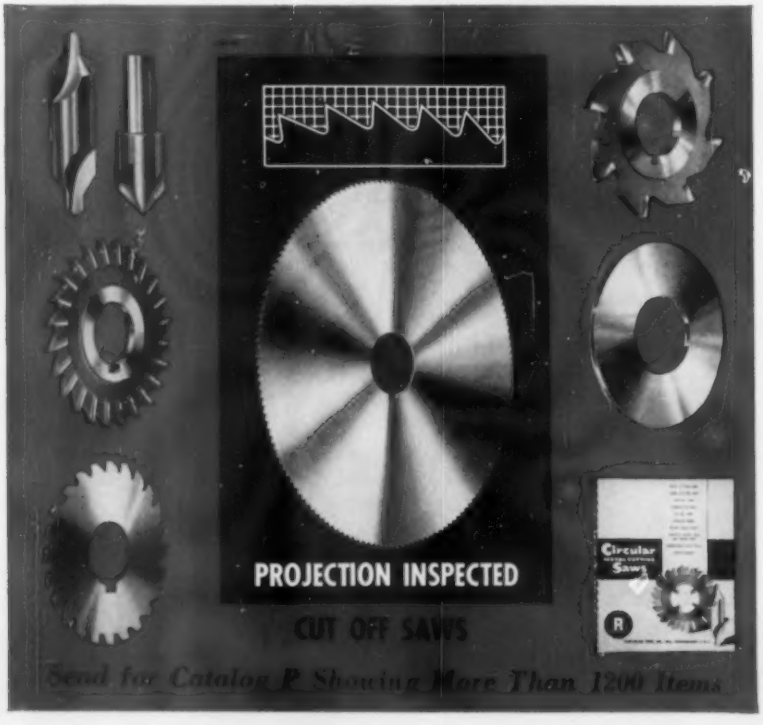

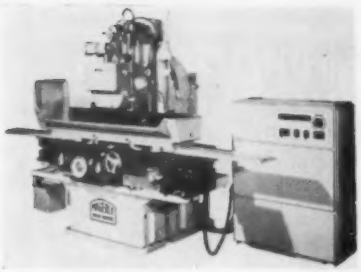

wheel diameter and the other compensates the present total downfeed of the wheel slide for the amounts the diameter of the wheel has been reduced by one of the two dressing methods. Downfeed in the wheelslide in the range of 0.00004 to 0.0004 inch, depending on the downfeed rate, is possible.

Eric R. Bachmann Co., Inc., 27-11 41st, Long Island, N. Y. **Circle 449**

Device Measures Surface Texture

Pictured here are five components—a tracer, a connecting link, a piloting unit, an amplifier and an electronic high-speed frequency counter—which make up a device for counting the aver-

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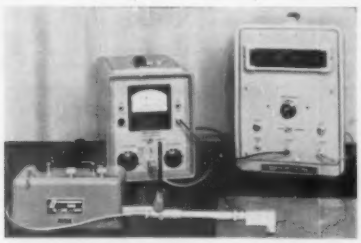
age roughness height readings and the number of surface peaks above a present level. The counter provides a three-digit readout and a standardizing circuit. The amplifier has an adjustable level control by which the peaks to be

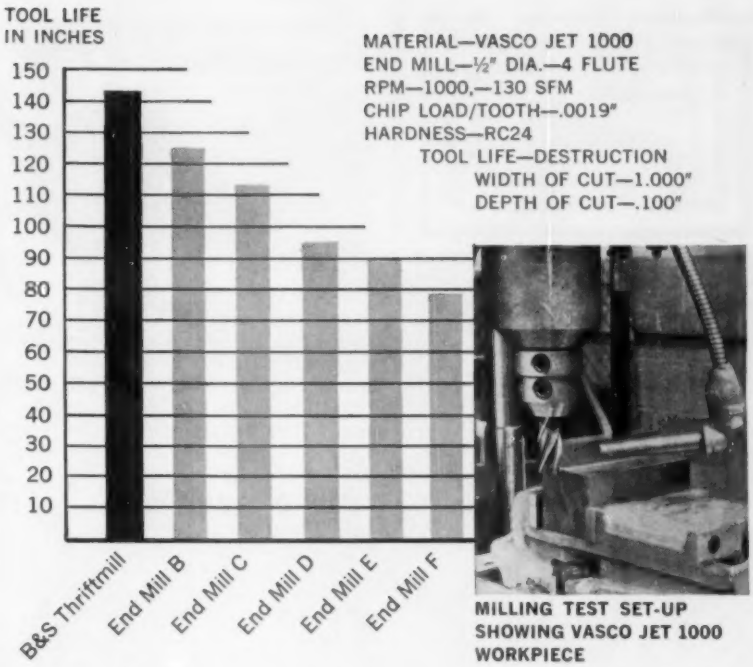


counted can be preselected according to their height in microinches. The piloting unit gives a gate trigger of one inch for the counter. The instrument is portable and is suited for inspection, quality control and production uses.

Micrometrical Mfg. Co., 3621 S. State Rd., Ann Arbor, Mich. **Circle 450**

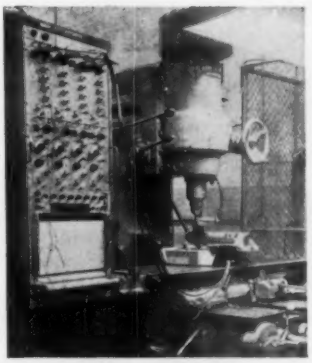
Punching Tool Makes 3½-Inch-Diam Holes

Holes with diameters between 2 and 3½ inches can be punched with this tool. The holder of the 5½-inch series tool is a semisteel casting cored for



MILLING TEST SET-UP SHOWING VASCO JET 1000 WORKPIECE

B&S Thriftmill® wins tooling torture test at North American Aviation!



8 CHANNEL RECORDER, DYNAMOMETER AND MILL.

Thriftmill cuts Vasco Jet 1000 Steel . . . 142 inches at 130 Surface feet/minute.

It is interesting to note that the best tool life of 142" at 130 SFM produced complete break down destruction of cutter, but in later tests, on the same hardness of material, 2016" of tool life with only a .010" wear land was acquired at a more normal speed of 43 SFM.

This (Thriftmill) cutter is unique from others in this series of tests for the reasons that it is cheaper to purchase than standard cutters and its geometry is quite different.

Of course, this is what B&S has been saying all along—THRIFTMILLS ARE DIFFERENT!

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Cutting Tool Division
Brown & Sharpe Mfg. Co.
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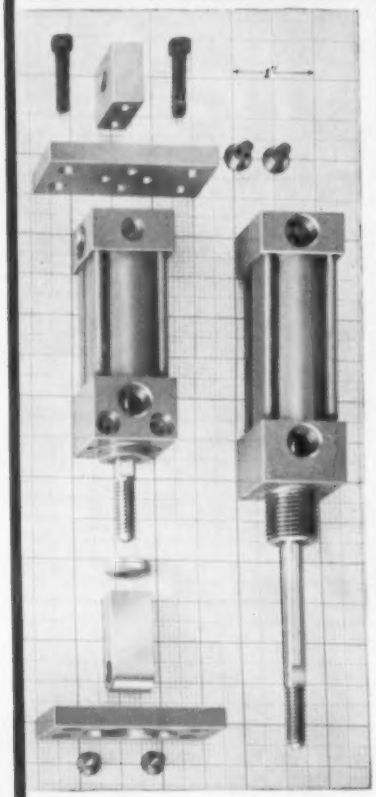

Hannifin offers new "Midget-Air" 200 psi cylinders in ¾", 1" and 1½" bores, double-acting or spring-return. Two basic models, "universal" and "nose-mounting." Universal models come drilled and tapped for mounting, or for use with any combination of the mounting attachments pictured. Delivery is off-shelf in standard strokes, shipment in ten days to specified stroke lengths. Want dimensions and prices? Write:

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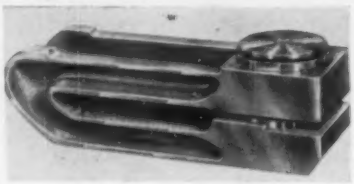
TOOLS of today

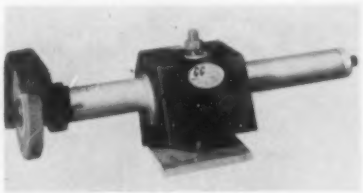


lightness and ease of handling. The units are available with 8, 12 and 16-inch throat depths. Punches are easily removed from the top and the die buttons can be removed from the front.

Tool Products Corp., North Tonawanda, N. Y. **Circle 451**

Toolpost Grinder Is Air Powered

This model T-P toolpost grinder uses the same quill for either internal or external operations. Complete visibility during all grinding operations is assured, because the grinder is operated by a 1-hp air motor enclosed inside



the quill. The motor has a top speed of 18,000 rpm and operates through 4:1 reduction gears to produce a maximum spindle speed of 4500 rpm. The motor and quill assembly has a 1⅞-inch diameter.

Gilmore Industrial Grinders, Inc., 6523 Eppes, Houston, Tex. **Circle 452**

Air-Hydraulic Unit Gives Fast, Slow Feeds

Whereas previous models of the air-hydraulic actuator had controlled traverse in the outward direction only, this unit has controlled traverse in both directions. By moving the two cams it is possible to set up any combination of fast, slow or skip feed strokes. A

built-in bypass valve with traveling rods allows rapid advance to any point in the stroke; controlled rate of feed for any distance; pickup to rapid feed; and return to controlled rate. This cycle

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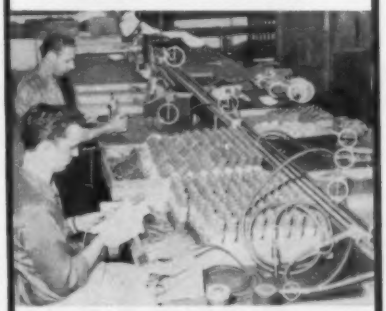
SERIES "D"—Interchangeable with all popular makes. Same construction as "A" series. Interchangeability reduces costly Coupling inventories.

SERIES "E"—a straight-thru type—permits unrestricted flow—has same inside diameter as nominal supply pipe or hose. Permits fast transfer of media.

SERIES "G"—double shut-off two-way check valve stops the flow from both lines when disconnected. Ideal for pressure loading of gases and fluids.



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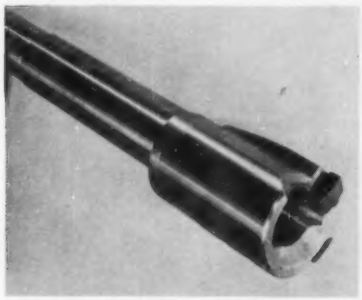
can be repeated several times during the stroke by setting the bypass valve cams. Stroke lengths from 2 to 8 inches are available in both the 2 and 3-inch-bore models.

Electro-Mechano Co., 241 E. Erie St., Milwaukee, Wis. **Circle 453**

Trepanning Tool Makes Holes in One Pass

Available with any diameter from 2 inches up, this trepanning tool produces holes in one pass. It can be used on turret lathes, boring mills, drill presses,

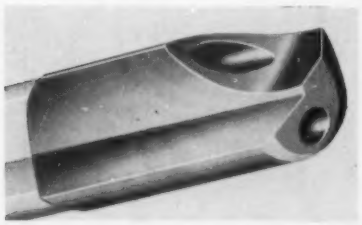


gun lathes or special turning machines. Exhaust is either ID or OD for use with or without coolant conductors. Bits are high-speed steel, carbide or Tantung.

Muskegon Tool Industries, Inc., Eleventh at Western, Muskegon, Mich. **Circle 454**

Gun Drill Has Double Cutting Fluid Flow

Two holes for cutting fluid flow instead of one is the major feature of the Double-Jet single-flute gun drill. One hole is in the top of the tip above the cutting edge to direct cutting fluid



at the cutting edge. The other hole, which is in the solid carbide tip underneath the cutting edge, forces the chips back along the chip space segment of the tool. Total flow of cutting fluid is doubled and chip backing along the shank of the tool is avoided with most work materials. Life between sharpenings is increased and only 0.010 to 0.015 inch of stock needs removing when resharpening is required.

Star Cutter Co. **Circle 455**

Cam Switch Allows In-Motion Adjustment

This multistage cam switch is designed primarily for use with equipment requiring a synchronous pulse or rapid adjustment while the switch is in motion. Its adjustment range is up to 180 deg for each stage. It is available with one to six cams which in turn can have any degree of dwell. Rated from

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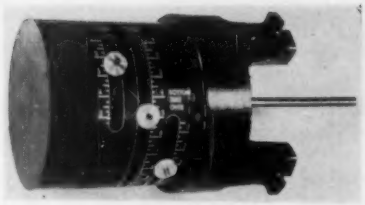
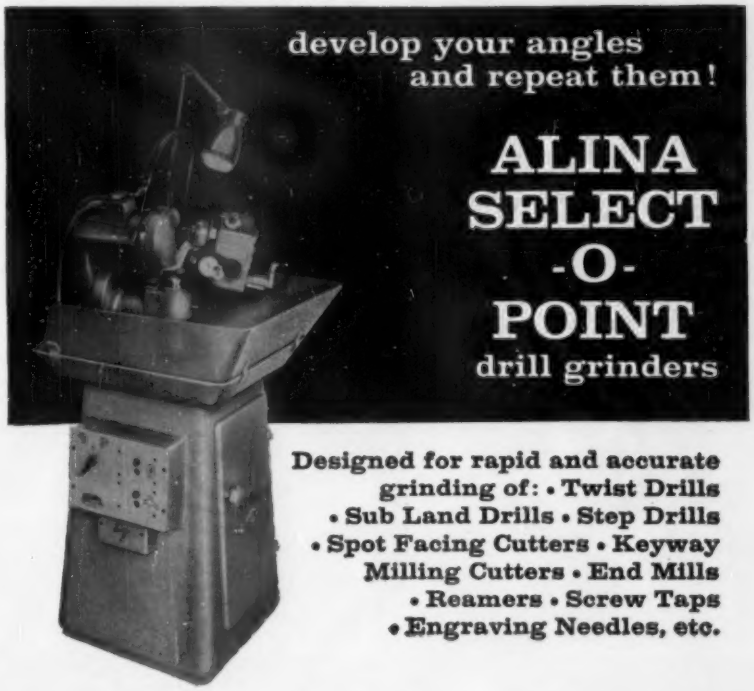


15 amp to 480 volt, a-c, the switch can have either clockwise or counterclockwise rotation. Upon reversal, the switch will not trip.

General Automation Corp., 121 Centre Ave., Secaucus, N. J. **Circle 456**



Designed for rapid and accurate grinding of: • Twist Drills • Sub Land Drills • Step Drills • Spot Facing Cutters • Keyway Milling Cutters • End Mills • Reamers • Screw Taps • Engraving Needles, etc.

Three models to choose from — No. 01-2 Range .004" thru .080" — No. 03-6 Range .012" thru .250" — No. 2-32 Range .080" thru 1.250". Each machine is a complete system built around a *planned drill point.* Increases drill life up to 200% by reducing drill thrust force — drills rounder holes to .001" tolerance without bushings or center punching — eliminates reaming operations—special sheet metal point, ground on model *No.2-32* produces round and almost burr-free hole. Accuracy and simplicity is built into each machine.

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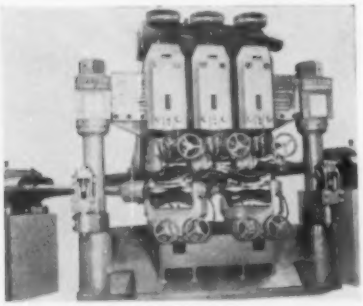
TOOLS of today

Machine Straightens Tube at High Speeds

Known as the 18SD, this five-roll rotary straightening machine operates at speeds from 175 to 700 rpm. It uses a 75 to 100-hp, 400 to 1600-rpm, d-c motor. Tubes with outside diameters from 1/16

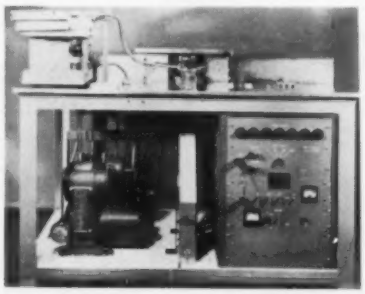


to 6 inches and bars with diameters from 1/16 to 4 inches in all metals can be straightened. The machine also handles 1/2 to 4-inch standard, line and extra strong steel pipe. The two large rolls are opposed by three small ones.

Sutton Engineering Co., First National Bank Bldg. **Circle 457**

Helixing Machine Handles Film Type Resistors

Shown here is the Model S-4 spiralling machine for making helix cuts on film type resistors to tune resistive values to the predetermined figures and tolerances. In principle, it is an automatic, self-loading and unloading lathe which repeatedly performs the spiralling operation under the guidance of a monitoring electronic controller. The controller brings all pieces to the same electrical resistance with a tolerance of ±0.5 percent. The unit will also sort out parts which are defective or which cannot be brought to value for one reason or



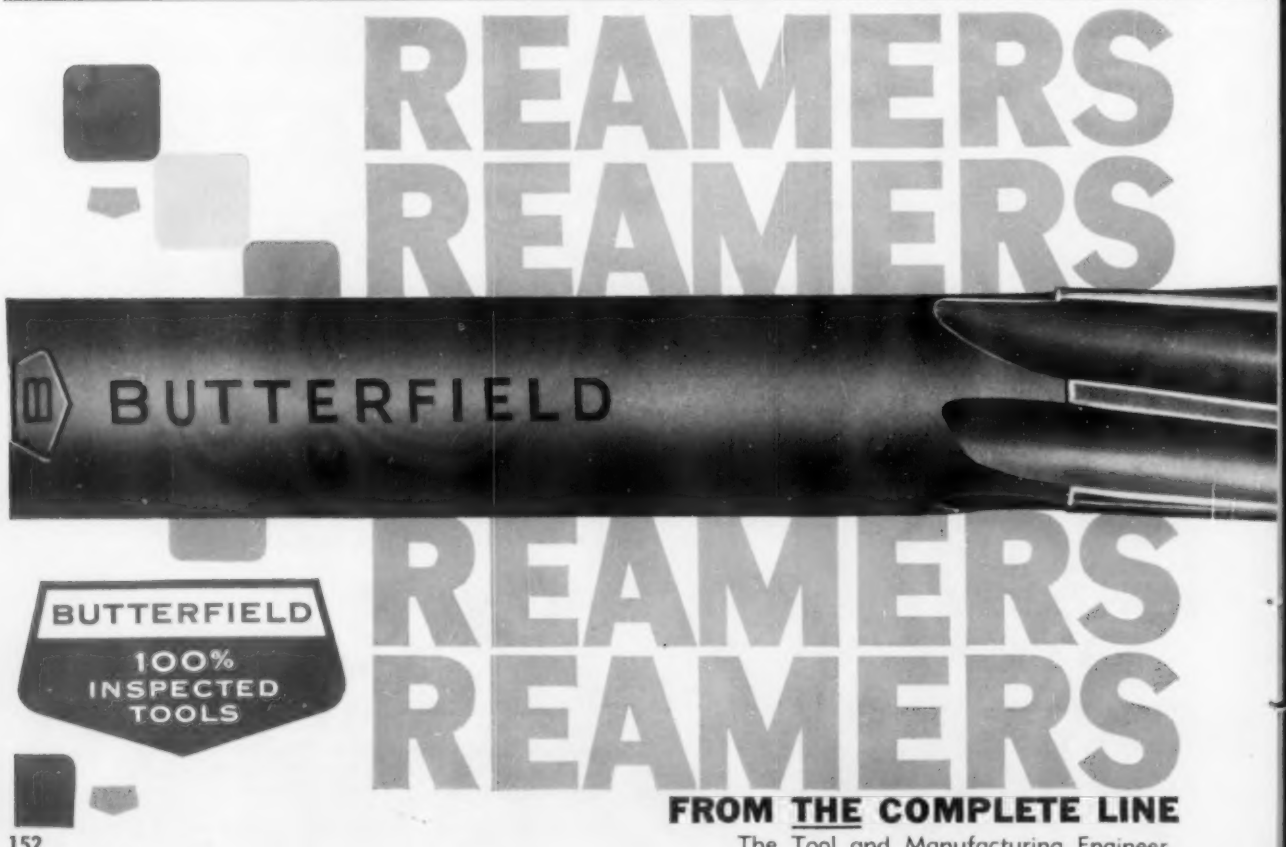
another. The machine will spiral up to 60 pieces per minute. Average at 5 spiral turns is 25 pieces per minute. Total nonspiralling time per cycle is 0.5 sec. Speed and feed are variable.

Sigma Engineering Service, Inc., Box 111, 26 W. Warren Rd., Custer City, Pa. **Circle 458**

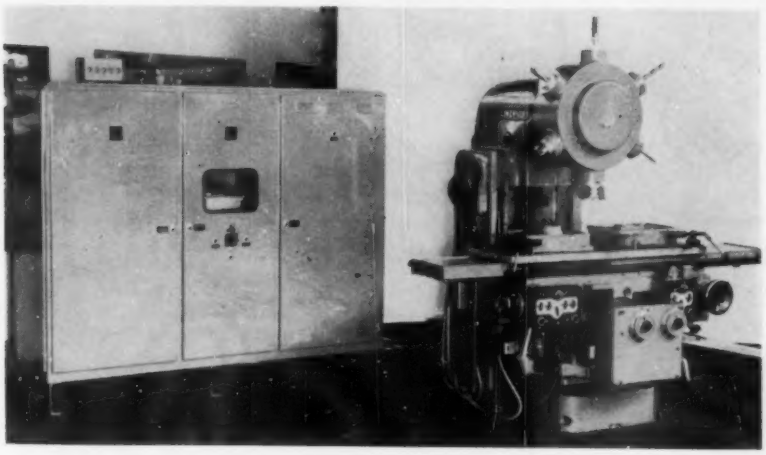
USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Design Device Aids Breadboarding, Programming

This system design aid can be used for programming digital and analog computers and for breadboarding circuitry. Called the Sealectoboard, it incorporates two planes of continuous contact strips running at 90 deg to each other and insulated between planes and strips. Insertion of a shorting plug interconnects the upper and lower strip at the desired X-Y intersection. Insertion of a diode plug, or other component plug, interposes the component at the desired point between the X and Y terminations. The device permits the interpositioning of components; the switching of functions in parallel or series operations; the interposing of associated circuitry at any point; and test equipment analysis of any point in the system. Sealectro Corp. **Circle 459**



Milling Machine Has Hex Turret

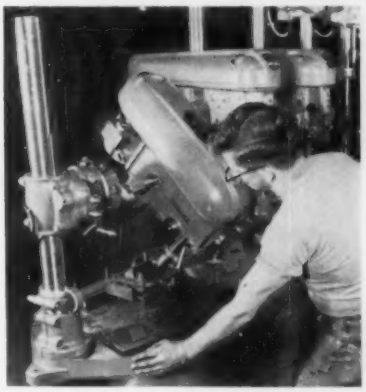


This machine—basically a vertical milling machine—has a hexagon turret which is controlled by a finger-tip switch or by punched tape. The turret makes the machine capable of performing in one setting without tool change surface and side milling, drilling and boring, and recessing and countersinking. Variable voltage signals to the tape control unit are compared with the input data to determine table position. When the two values coincide, a relay stops the table. The system is an analog feedback system. With spindle speeds of 35 to 1800 ipm, the machine is useful for large or small-lot production.

Marac Machine Corp., 108 Grand St., White Plains, N. Y. **Circle 460**

Radial Drill Has Versatile Design

Because it is designed so that the tool is moved and positioned instead of the work and because it can be moved from one work area to another, the Delta Unidrill is a versatile 2-ft-arm radial drill press. The operator can position the cutting tool in five ways: he can move it up and down on the main column; swivel it 360 deg around the column; rotate the head around the mounting post; move the head in and out from the column; or tilt the head 45 deg left or right. The machine has six interchangeable spindles or spindle adapters. The 23½ x 25⅛-inch table has parallel T-slots and 1½-inch front



and side clamping ledges. A multispeed attachment allows 12 different speeds from 185 to 10,800 rpm.

Rockwell Manufacturing Co., Power Tool Div. **Circle 461**

BUTTERFIELD
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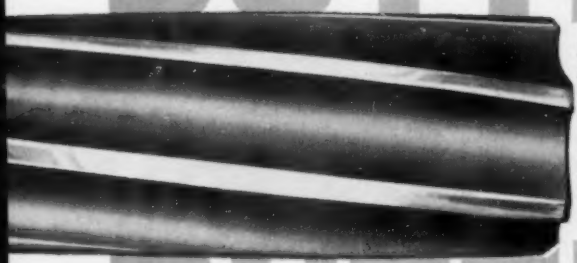

Sharing the proved performance and long life engineered into the complete Butterfield line, Butterfield reamers cut freely and size holes accurately and uniformly — when used alone or in multiple tool machining. Butterfield production performance like this, plus prompt deliveries and expert technical aid, will reach your plant fast . . . wherever it's located, whatever you machine . . . Call your Butterfield Distributor today. Warehouses in Chicago, Detroit, Fort Worth, Los Angeles, New York and San Francisco.

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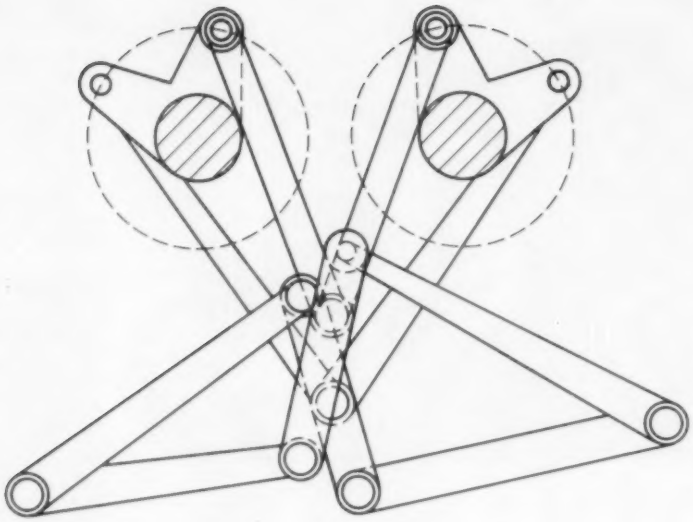

You Name It...

"Every Mechanic, Inventor and student of the mechanical arts should study to avoid clumsiness in the construction of mechanical devices and so arrange any mechanism which he may wish to produce with the least number of parts possible."

So spake *The Inventor's Universal Educator*, a nineteenth century tome which may well have been read by Henry Ford, the Wright Brothers—perhaps by Eli Whitney himself. In any event, we're certain that the author, a self-styled "mechanical expert," had his tongue in his cheek when he edited this delightful bit of nonsense. (In case you haven't guessed, this gadget is an example of "Noiseless gearing for two shafts running in opposite directions.")

We disclaim responsibility for injuries incurred by those who attempt to build this type of gearing . . . but we would like to hear from them as soon as they're up and around again.

Meanwhile, we suggest that you let this mechanical fantasy serve as a reminder that good gadgets—gadgets that perform a useful service and will be of interest to your fellow engineers—are wanted for the Gadgets Contest in volume quantities.

Incentives? We're appealing to your baser instincts and are offering you money. You can win one of the monetary prizes and, in addition, be paid an honorarium if your entry is published.

Here are the rules to follow:

- **Contest is open to ASTME members only**
- **Entries must be limited to 500 words**
- **Sketches in lieu of finished drawings will be accepted**
- **Entries will be judged by the Editorial Committee on the basis of originality, conciseness and completeness of presentation**
- **Prizes: First prize $100; two second prizes of $50; four third prizes of $25; and honorable mention awards to all close runners-up.**

Don't forget—the Gadgets Contest closes December 31. Send your entry to the Gadgets Editor, THE TOOL AND MANUFACTURING ENGINEER, 10700 Puritan Avenue, Detroit 38, Mich.

Field Notes

THREE MEN from Chambersburg Engineering Co., Chambersburg, Pa., will receive Edward Longstreth medals from the Franklin Institute for their method of forging metal into parts by use of a horizontal forging hammer based on the counterblow principle. The men are Robert L. Alcorn, Jr., research engineer; Eugene C. Clarke, former president and now director; and Henry A. Weyer, chief engineer. The Impacter, introduced in 1952, facilitates the production of parts such as rocket fin blades, rifle components, tableware, scissors, pliers, wrenches and automotive parts. It eliminates shock and vibration and, because of the momentary contact between die and work, conserves heat in the forging.

acquisitions

Lindberg Steel Treating Co., Inc., of Melrose Park, Ill., has acquired 100 percent stock ownership of Lakeside Steel Improvement Co. The Cleveland firm has annual sales in excess of $1,000,000. Lindberg has an annual sales volume of more than $6,200,000 and plant facilities in Chicago, St. Louis, Rochester, N. Y., and Los Angeles. J. H. Ries serves as president of Lakeside. Lindberg's president is L. A. Lindberg.

The acquisition of Wafe Manufacturing Co., Inc., has been announced by Miniature Precision Bearings, Inc., of Keene, N. H. The Bridgeport, Conn., designers and manufacturers of tools and dies will be operated as Wafe Div of MPB, Inc.

Racine Hydraulics & Machinery, Inc., producer of hydraulic components for industrial uses, has acquired a one-third interest in Gettys Manufacturing Co. John E. Erskine, president of Racine Hydraulics, said Gettys will share responsibility in the design, installation and servicing of complete electro-hydraulic systems for his firm. The merger of interests between the two Racine, Wis., firms leaves Gettys free to continue its special development and manufacturing services to other clients.

Reed Roller Bit Co. has purchased Diamond Metal Co., Houston, Tex. Diamond Metal manufactures tungsten carbide surfacing materials and coatings and a line of tungsten metal used as a shield against radiation. Reed currently manufactures metal surfacing materials under the name CleMet Products. Through the consolidation, Reed will integrate its hard metals production with Diamond Metal and discontinue production of CleMet Products.

Sunbeam Equipment Corp. has acquired Mern Industries of Oconomowoc, Wis. The purchase included all engineering, patent rights and plant equipment used by Mern in its manufacture of heat-treating furnaces and equipment. The operation will be integrated with the Sunbeam line of furnaces at Sunbeam headquarters in Meadville, Pa.

Establishment of a spray equipment manufacturing and distributing facility in Australia through an agreement with C.I.G., Ltd., has been announced by DeVilbiss Co., Toledo. The affiliate is known as Arnold-DeVilbiss Pty., Ltd. Its headquarters are in Sydney, New South Wales. C.I.G. has produced spray painting equipment for the past 25 years.

new activities

Formation of a new division with sole responsibility for the design and development of automatic programming systems for Minneapolis-Honeywell computers has been announced by the company's Electronic Data Processing division. Walter W. Finke, EDP division president, said the new unit, to be known as the Programming Systems division, has been established in recognition of "the increasingly vital role that automatic programming is playing in the current development of the electronic data processing industry." Joseph H. Levin will serve as director of the division.

McKay Machine Co., Youngstown, Ohio, has been licensed to manufacture lines of metal processing equipment formerly manufactured by Wean Equipment Corp., Cleveland. McKay recently merged with Federal Machine and Welder Co. of Warren, and is operating as its Federal-Warco Div. McKay has been sales representative for Wean Equipment since Feb. 1960.

Steel Improvement and Forge Co., Cleveland, has just concluded an agreement with Birmingham Small Arms Co., Ltd., of Birmingham, England, whereby the British tool manufacturer has been granted the right through its subsidiary, B.A.S. Tools, Ltd., to build and market the Cleveland company's new electrochemical metalworking machines. In the process, the parts to be machined and the electrodes are held within a chamber through which a chemical solution flows. An electric current, passing through the fluid from the workpiece to the electrodes, removes the metal. There is no metal-to-metal contact between the workpiece and the tool, and no tool pressure. Steel Improvement and Forge Co. makes precision and custom rough forgings for the aircraft, missile, road building, oil, mining, machine tool and general machinery industries.

mergers

The boards of directors of Bowmar Instrument Corp., Ft. Wayne, Ind., and Technology Instrument Corp. have approved terms for the merger of the two companies. One share of Bowmar stock will be exchanged for each 3.3 shares of TIC stock. Bowmar will be the surviving corporation. Bowmar manufactures electromechanical servomechanisms, gearheads and counters, and other components for instrumentation of missiles, satellites and supersonic jet aircraft. It also produces instruments for industrial applications. TIC is engaged in the manufacture of potentiometers for use in computers, servo systems, aircraft, missiles, rocket controls and navigation devices and in industrial controls. TIC also manufactures electric apparatus including laboratory phase measuring instruments.

The merger of Grieder Industries, Inc., into Pines Engineering Co., Inc., has been announced by the two firms. The manufacture and sale of Grieder high-speed tube cutoff machines, automation equipment, and special machinery expands the Pines line of tube fabricating equipment. All executives and key operating personnel, as well as equipment, have been moved to the Pines headquarters in Aurora, Ill. Operations are being discontinued at the Grieder plant in Bowling Green, Ohio.

expansions

Scherr-Tumico, Inc., manufacturer of measuring tools and instruments, has announced that it has signed a contract with the government of Israel to build a plant which will manufacture a com-

plete line of mechanical, optical and electronic measuring devices. Location of the 17,000-sq ft plant is tentatively set for Haifa. The facilities will include a metrology laboratory, toolroom, machine shop, heat-treating department, etching department, electroplating department and inspection room.

National Lead Co. has announced the start of production at its new die casting plant at Boulogne, Argentina. The plant supplies die castings to Argentina's automotive industry and to manufacturers of washing machines, refrigerators, hand tools, business machines and other appliances. The plant, occupying a six-acre site, is National Lead's third overseas die casting operation.

Plans to manufacture automotive bearings in Mexico and to offer majority interest in its subsidiary, Clevite de Mexico, S.A. de C.V., to Mexican investors have been announced by Clevite Corp. Fifty-five percent of the ownership of the company will be offered to investors. The Cleveland corporation will retain minority interest in the company.

association news

The Western Section of the Society of the Plastics Industry, Inc., has selected J. Allen Carmien, president of New Plastic Corp., Los Angeles, as its 1961-62 chairman. Carmien was vice president during 1960-61. Other officers serving for the coming year are vice chairman, Frederick M. Rea, publisher of Western Plastics magazine; secretary, Warren Buschmann, Union Carbide Plastics Co.; and treasurer, Charles Wurdeman, Rezolin, Inc.

moves

R. D. Wood Co. has moved its general offices from the Public Ledger Bldg. in Philadelphia, Pa., to Florence, N. J. All activities involved in the company's manufacture of hydraulic presses and allied equipment for the metalworking, woodworking, plastics and rubber industries are now concentrated in one location. The company also manufactures cast iron pipe, fire hydrants and gate valves.

Southern Metallurgical Co., a 5-month-old Tulsa, Okla., enterprise, has outgrown its original quarters at 21 N. Cheyenne Ave. and has moved into a larger leased building at 1115 N. Utica Ave. Additional machinery has been installed in the 4000-sq ft quarters. The firm provides a cleaning, grinding and honing service for metal parts used in missiles, aircraft, parking meters and electronic instruments.

Metal Masters Co., designers and builders of special industrial machines and equipment, has moved to new and larger facilities located at 2601 W. Diversey Ave., Chicago. The plant has 8000 sq ft of floor space.

Geoscience Instruments Corp. is moving to larger facilities at 110 Beekman St., New York 38, N. Y. The headquarters will house a materials processing laboratory in addition to equipment for fabricating and finishing metals, ceramics and exotic materials.

Early in 1962, Master Electric Div. of Reliance Electric and Engineering Co., Dayton, Ohio, will complete the moving of its operations to two new plants in Columbus and Madison, Ind. The 210,000-sq ft Columbus building will serve as headquarters for the division. The

New ARMSTRONG "90" SERIES RATCHET

The ONLY Ratchet with ALL these important features!

1 Slenderized head
2 Thumb-operated reversing lever specially designed so it won't come off
3 Reversing-lever stop (Ball-and-spring prevents accidental shifting)
4 Simple to clean—only tool required is a Phillips screwdriver (wearable parts may be individually replaced)
5 Thin handle with knurled grip
6 Hole in handle for convenient hanging
7 Fine-toothed gear
8 Easy ratcheting action
9 ¼", ⅜", and ½" square drives (two handle lengths in ½" drive)
½"
½"
⅜"
¼"

All wearable parts are replaceable; individually, inexpensively, easily. With no teeth cut into handle, it need never be replaced. *"ARMSTRONG" on these ratchets guarantees: advanced design, top quality and tool sense.

Extra heavy duty "50" Series ARMSTRONG ratchets (see right) in 1", ¾", ½" and ⅜" square drive sizes. Our General Catalog 700, gives complete information on these and approximately 5500 other ARMSTRONG tools. Your local ARMSTRONG Distributors will supply you a Catalog and demonstrate the new ratchets. If you don't know who he is, write us for his name.

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Madison building will have 160,000 sq ft of floor space. Fractional horsepower and specialty motor production will be concentrated in the Madison plant and gearmotor manufacture will take place in Columbus.

new facilities

Futurmill, Inc., Pontiac, Mich., has purchased a new plant at 19720 W. Eight Mile Rd. The company completed the move of its equipment for manufacturing milling cutters, planer conversion spindles and accessories and other milling and metal removal tools around the first of August.

Ground has been broken for a $600,000-addition to plant facilities of Sawbrook Steel Castings Co., Cincinnati, Ohio. The addition will increase the size of Sawbrook's plant by nearly 20 percent. The new section is being erected adjacent to the company's present foundry.

Kaydon Engineering Corp., Muskegon, Mich., is investing slightly more than $1,000,000 in a plant improvement program this year, including a 15,000-sq ft plant addition. Included in the program are the rearrangement of departments to improve work flow and minimize material handling, modernization and enlargement of the inspection and assembly areas, and installation of a quality control laboratory.

A new plant for producing extrusion dies for the West Coast extrusion industry is announced by John Wall, president of PMD Extrusion Die Co., of Warren, Mich. Located at 1309 Bayshore, San Jose, Calif., the new plant will supplement existing extrusion die manufacturing facilities at Warren and Florence, Ala. PMD is one of a family of individual companies including Permanent Mold Die Co., Piston Mold Die Co. and Permanent Machine and Tool Co. The San Jose plant will be under the direction and supervision of A. W. Hamel.

A multimillion dollar plant which boosts beryllium metal fabricating capacity of the Brush Beryllium Co. by 50 percent has started production. The facility, when completed later this year, will represent a $3,000,000 investment in plant and equipment and will replace three smaller fabricating locations in Cleveland. President George S. Mikhalapov said that the new 90,000-sq ft plant is "one aspect of an integrated effort at Brush to bring the cost of beryllium down while increasing production capacity to meet growing demands."

Harig 612
SURFACE GRINDER
with
NEW...EXCLUSIVE
AUTOMATIC FORCED LUBRICATION

- Continuous flow, recirculating system
- Washes away damaging grinding dust
- Triples life of ways
- Preserves original accuracy
- Promotes easy table operation
- Reduces maintenance—*oils complete machine*

...and many other features included as standard equipment, all at a surprisingly low price!

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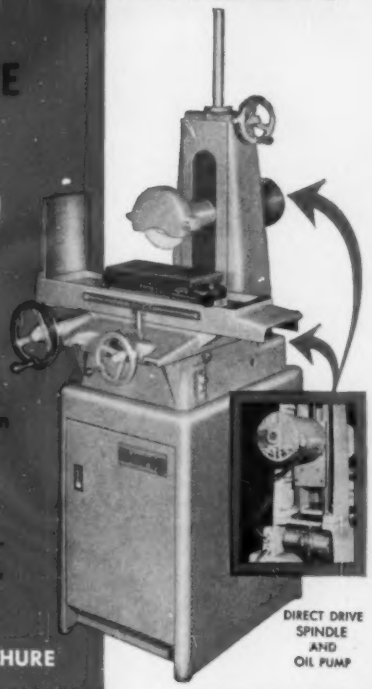
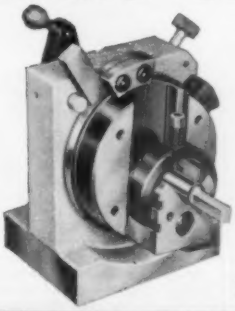
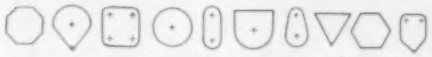


THE FASTEST WAY TO GRIND PERFORATORS . . . INCREASE ACCURACY

HARIG GRIND-ALL FIXTURE



Easily grinds irregular shaped perforators concentric with shank within ± .0001 accuracy. Also can be used for milling, boring, and inspection. New features include V-block adjusting screw and sine arrangement to obtain any desired angle. Attachment available to convert Grind-all into precision Radius Dresser.



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who's meeting and where

Oct. 5-8. AMERICAN SOCIETY OF INDUSTRIAL DESIGNERS. Theme of the annual meeting will be "Design Explorations." Santa Catalina Island, Los Angeles, Calif.

Oct. 9-11. National electronics conference sponsored by the AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, the INSTITUTE OF RADIO ENGINEERS and the INSTRUMENT SOCIETY OF AMERICA. Bradford Hotel, Boston, Mass.

Oct. 9-11. NATIONAL ASSOCIATION OF CORROSION ENGINEERS. North central regional conference. Chase-Park Plaza Hotel, St. Louis, Mo.

Oct. 9-13. SOCIETY OF AUTOMOTIVE ENGINEERS. National aeronautic meeting. Ambassador Hotel, Los Angeles, Calif.

Oct. 9-13. Workshop course, called "Arc Welding Inspection and Quality Control," conducted by Hobart Brothers Technical School. Troy, Ohio.

Oct. 10-12. AMERICAN STANDARDS ASSOCIATION. National conference. Rice Hotel, Houston, Tex.

Oct. 17-18. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Materials handling conference. Pick Nicolette Hotel, Minneapolis, Minn.

Oct. 17-19. Joint lubrication conference sponsored by the AMERICAN SOCIETY OF LUBRICATION ENGINEERS and the AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Morrison Hotel, Chicago, Ill.

Oct. 18-20. AMERICAN SOCIETY OF BODY ENGINEERS. Sixteenth annual technical convention. Out of 12 papers to be presented, over half are related to corrosion problems. Rackham Memorial Bldg., Detroit, Mich.

Oct. 18-20. GRAY IRON FOUNDERS' SOCIETY. Thirty-third annual meeting. Royal York Hotel, Toronto, Can.

Oct. 19-20. National conference on industrial hydraulics sponsored by the Illinois Institute of Technology and its affiliate, Armour Research Foundation. Theme of the conference is "Versatility and Reliability of Fluid Power." Sherman Hotel, Chicago, Ill.

Oct. 19-21. NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS. Fall meeting. Hotel Roanoke, Roanoke, Va.

Oct. 23-25. ABRASIVE GRAIN ASSOCIATION. Fall meeting. Waldorf-Astoria Hotel, New York City, N. Y.

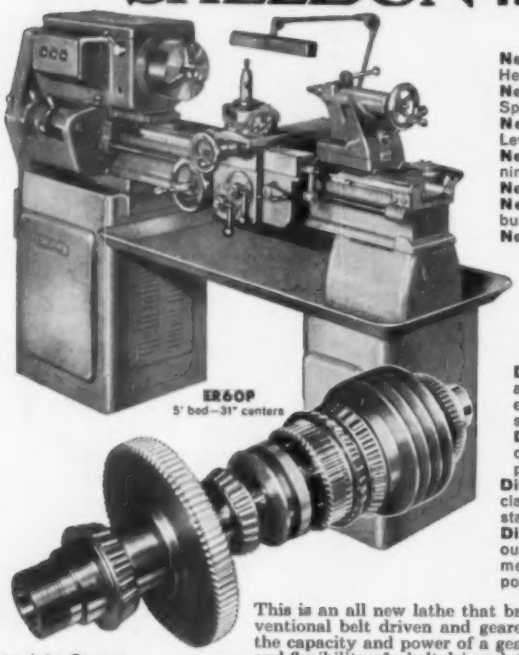
Oct. 23-27. AMERICAN SOCIETY FOR METALS. National metal congress and exposition. Ten technical societies and trade associations, with a combined membership of more than 100,000, will present 62 technical sessions. Cobo Hall, Detroit, Mich.

Oct. 25-26. Computer applications symposium sponsored by the Armour Research Foundation of the Illinois Institute of Technology. Morrison Hotel, Chicago, Ill.

Oct. 25-27. NATIONAL MANAGEMENT ASSOCIATION. Annual convention. Sherman Hotel, Chicago, Ill.

Oct. 26-27. AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS. Semi-annual meeting. Royal York Hotel, Toronto, Can.

Both NEW *and* DIFFERENT SHELDON 15" PRECISION LATHES



NEW

New. Revolutionary double-box Headstock (Pat. Pend.)
New. "WORK-HOLDING ONLY" Spindle.
New. Single-Shift Back Gear Lever on Headstock.
New. Headstock and Apron running in oil.
New. 1¼" Hole through Spindle.
New. 60-pitch Gear Box with built-in Lead Screw Reverse.
New. Amazing LOW PRICE.

DIFFERENT

Different. Spindle rigidly held in two large "Zero Precision tapered roller bearings arranged in box-type design.
Different. Electrical switches and push-button stations fully enclosed in built-in well in headstock.
Different. Two independent clutches in apron for selecting power feeds.
Different. Cam-action tailstock clamp for rapid release and instant locking of tailstock.
Different. Triple, cogged, V-belt outboard drive—eliminates intermediate shafts—delivers more power to spindle.

This is an all new lathe that bridges the gap between conventional belt driven and geared head lathes. It combines the capacity and power of a geared head with the economy and flexibility of a belt driven lathe. Available with 5', 6' and 8' bed lengths providing 31", 42" and 66" center distances.

Send in Coupon or full information

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Gentlemen: Please send me information on items checked.

- ☐ The NEW and DIFFERENT SHELDON 15" Lathes
- ☐ Sheldon ☐ 10" ☐ 11" ☐ 13" Lathes
- ☐ 11" and 13" Variable Speed Lathes
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Quality... the best economy of all

Another product of Sunoco research ... a fire-resistant hydraulic fluid

The flame test, above, dramatizes the effectiveness of Sun's new fire-resistant hydraulic fluid. The wick in the conventional fluid burns readily; the wick in Sun's new fluid just can't be lighted.

SUNSAFE, a water-in-oil emulsion, eliminates fire hazards ... provides increased safety to personnel and equipment. At the same time, operators get the essential performance characteristics of a top-grade hydraulic oil—low rates of wear, long service life, and protection against rust and corrosion.

This combination of *quality* in engineering know-how, and *quality* in product, proves once again that *quality* in any sense is the best economy of all.

For 73 years Sunoco has meant quality right down the line. Today, this quality is found in more than 400 Sunoco industrial products. SUN OIL COMPANY, Phila. 3, Pa., Dept. I-14.
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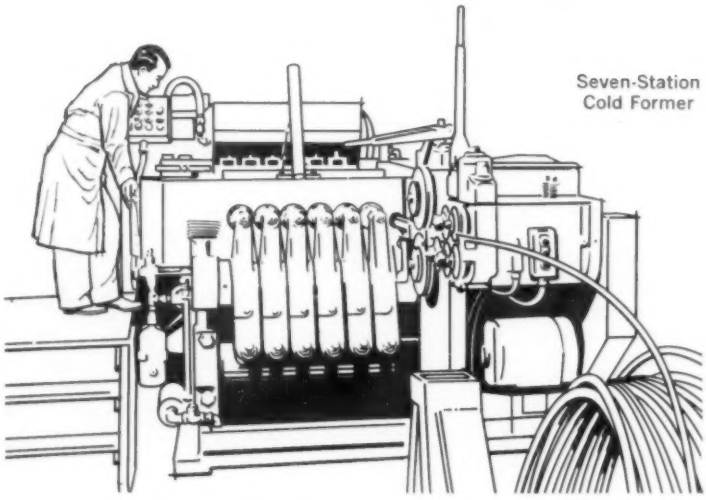
A New Look at Cold Forming!

The new National Seven-Station Cold Former now lets you make parts you had "shelved" as impractical. Six- and seven-station Cold Formers are routinely producing the formerly "impossible" jobs. Many are formed scrapless, most are practically finished, all are cold-formed automatically from coiled wire.

Production rates for these parts range from 45 to 115 *per minute!*

If you make odd-shaped parts, may we help you evaluate them for the potential that awaits you with these new Cold Formers? Come to Tiffin, witness our demonstrations and let's discuss your work.

No obligation.



Seven-Station Cold Former

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Men at Work

Newly elected president and chief executive officer of E. W. Bliss Co. is **Carl E. Anderson** (pictured below). Anderson was also elected to the board of directors of the company. Before joining Bliss, he was director of general

management consultation for Ebasco Services Inc., a management consulting, engineering and construction firm. Anderson will make his headquarters in Canton, Ohio.

F. W. Witzke has been appointed vice president and chief administrative officer of the Cleveland Instrument Co., Cleveland, Ohio, a subsidiary of the Bendix Corp. Witzke, previously manager of sales engineering, joined the company in 1956.

Staunton Williams (pictured below) was recently promoted to the post of chairman of the board and chief executive officer of Capewell Mfg. Co. In his new capacity for the Hartford,

Conn., company, Williams immediately announced the election of **Philip C. Sayres** as president. Sayres is at present administrative vice president of Richardson-Merrel Inc., formerly Vick Chemical, and was previously executive vice president of American Can Co.

Hupp Corp., Los Angeles, has elected three executives to key positions in its Gemco, Inc., subsidiary. They are **Fred W. Hottenroth,** president; **Jack J. Lane,** vice president in charge of marketing; and **Jerome Belsky,** vice president in charge of manufacturing and engineering.

The appointment of **C. C. Dybvig** (pictured below) to the newly created position of vice president of marketing for Dana Corp., Toledo, has been an-

nounced. Dybvig joined Dana in 1954 as general sales manager and in 1958 was elected vice president in charge of sales. In this new position, Dybvig will continue with his present sales responsi-

bilities as well as the coordination of sales for Dana's Detroit, Con-Vel, and transmission and gear divisions.

Carel Abresch (pictured above) has been promoted to vice president of product engineering for Waste King Corp., Los Angeles. His responsibilities will include the development of new and current products as well as production engineering and quality and reliability engineering for the appliance manufacturer. Before joining Waste King, Abresch held posts with General Electric Co. and General Motors Corp.

Bernard J. Mezger (pictured below) has been appointed manager of technical coordination at Gleason Works, Rochester, N. Y. Mezger, formerly a research and development manager with Radio Corporation of America and

Curtiss-Wright Corp., will be responsible for the coordination of advanced engineering activities.

Chrysler Corp., Detroit, has completed the alignment of its marketing organization into two separate automotive sales divisions, combining the Chrysler Imperial Div. and the Plymouth Div. as Chrysler-Plymouth Div. **C. E. Briggs** has been appointed vice president and division general manager. He formerly headed the Chrysler Imperial Div. **R. D. Armstrong** was named assistant division general manager. **H. E. Chesebrough,** formerly vice president and division manager of the Plymouth Div., has been named vice president and director of quality control.

Harold F. Robinson (pictured above) has been named to the newly created post of numerical control engineer by Harron, Rickard & McCone Co., Los Angeles. Formerly facilities engineer with Douglas Aircraft Co.'s Long Beach Div., Robinson has had extensive back-

ground in the machine tool field. In his new position, he will lend support to the rapidly expanding field of numerical control, with concentration in the areas of familiarization, education and profitable application.

New vice president of sales of the Atkins Saw Div. of Borg-Warner Corp. is **Robert V. Merrell.** In this capacity, Merrell will be responsible for all sales, advertising, market research and customer relations. He has been associated with the wood and metalcutting saw firm for the last 12 years. During this time, he has served as sales manager, assistant sales manager and general sales manager.

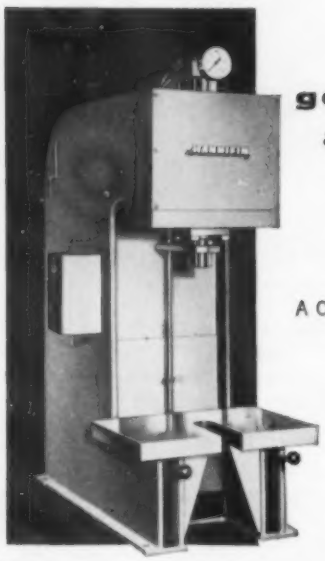
Howard A. Finch, manager of marketing for Jones & Lamson Machine Co., has been named president of Amertool Services, Inc. At the same time, **J. A. Gerard,** vice president of Cone Automatic Machine Co., was elected vice president. Finch succeeds Nelson F. Caldwell, who had been president of Amertool since its establishment. Caldwell becomes chairman of the board for 14-company concern organized for providing technical selling and servicing assistance to the foreign distributors of the member companies.

G. M. Diehl Machine Works, Inc., has announced the appointment of **Charles W. Tuttle** (pictured above) as president. Tuttle has served as executive vice president since June 1958 and was previously vice president and general manager of Indiana-McKay Foundry Corp. He succeeds John A. Collinge.

The appointment of **Raymond S. Fries** to a new post as manager of manufacturing and engineering of Minneapolis-Honeywell's Brown Instruments Div. has been announced. In 17 years with Honeywell, Fries has been manager of new products and their manufacturer in Minneapolis, manager of the appliance controls division at Gardena, Calif., and manager of operations for production facilities for the commercial division.

Leonard J. Linde has been appointed director of engineering for the Allis-Chalmers Manufacturing Co. Industries Group. Linde joined the company in 1950 and for the next four years served as assistant general manager and chief engineer of the Boston Works. He was transferred to West Allis in 1954 and appointed director of electrical engineering. Between 1957 and 1960, he served as manager of C Stellarator Associates.

Claude W. Mason and **Frank J. Hoyne** have been appointed vice president and assistant general manager and vice president of sales, respectively, for the Mechanics Universal Joint Div. of Borg-Warner Corp. In two other organization changes, **Roy McCaslin, Jr.,** was named secretary-treasurer and **James Peterson** was chosen assistant general sales manager. Mason has been associated with the division for more than 14 years, handling managerial responsibilities at both the Rockford, Ill., and Memphis, Tenn., plants. He was appointed secretary and treasurer of the division in 1957, the position he held



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when his new assignment was announced. Hoyne has been with the division since 1959, serving first as West Coast district sales manager and later as general sales manager.

Advanced Vacuum Products, Inc., of Stamford, Conn., has announced the appointment of **Herbert Schwartz** as vice president and general manager. Advanced Vacuum, producers of high temperature ceramic-to-metal seals, is a subsidiary of Glass-Tite Industries, Inc. For the past six years, Schwartz has been president of Duramic products and a member of Duramic's parent firm, Accurate Specialties Co.

Three men—**E. Nevin Kather, John T. Thompson and Kenneth M. Lord**—have been named to new posts by Raytheon Co., Lexington, Mass. Kather and Thompson, vice presidents, become general manager of the semiconductor division and general manager of the distributor products division, respectively. Lord will serve as vice president in charge of manufacturing and purchasing.

Dan E. Baker has been appointed vice president and a member of the board of directors of Androform Industries, North Dighton, Mass. Baker will be responsible for marketing activities including the sales of the company's line of machines and services for the dieless forming of metals. He was formerly vice president of marketing for Atlee Corp.

William F. Aylard, formerly director of engineering, has been named a vice president of Chase Brass & Copper Co. He will continue to make his headquarters at the firm's main office at Waterbury, Conn., where, in his new position, he will be responsible for the coordination of the research, engineering and product development divisions.

Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., recently announced that **John H. Batten** (pictured above) has been appointed to the board of directors to fill the unexpired term of **William E. Buchanan.** Batten has been president and general manager of Twin Disc Clutch Co., Racine, Wis., since 1948. Buchanan, president of Appleton Wire Works, Appleton, Wis., continues on the G & L advisory committee to the board of directors.

The appointment of **Don T. McKone, Jr.,** as executive vice president in charge of domestic manufacturing and sales operations has been announced by Aeroquip Corp. Prior to his promotion, McKone was a vice president and a director of the Jackson, Mich., company. He has been with Aeroquip since 1949.

Asa E. Snyder has been elected vice president of Pratt & Whitney Co., Inc., West Hartford, Conn. Snyder, formerly director of research, will continue to supervise the operations of the research department. He came to Pratt & Whitney in 1960 from U. S. Industries technical center in Pompano Beach, Fla.

Robert B. Ayres was elected president and treasurer recently by the Leon J. Barrett Co., Worcester, Mass. Ayres has been with the company since 1950 and, for the past nine years, has been sales manager.

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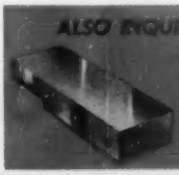

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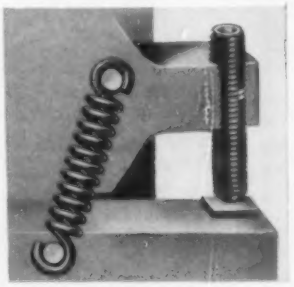

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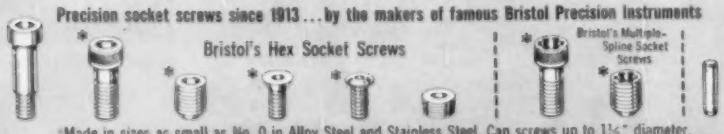

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.....readers' viewpoints

. . . heart surgery

To the Editor:

Early this year Mr. Donald F. Reck, an engineer from Muskegon, Mich., wrote regarding the articles on heart surgery in TME. He asked questions about the shunt clamp and later came to Ann Arbor to get additional details. Soon after, he produced a pair of excellent clamps having the requested design. Clamp teeth were shaped properly and were able to hold the vessel wall without damaging the tissue.

The basic research has been completed and we are now requesting various sizes of clamps so we can perfect the technique of their use in heart surgery . . .

Clarence E. Crook, M.D.
President
Cardio Vascular Research Association

. . . engineering education

To the Editor:

The ideas in the article, "The Role of Science in American Manufacturing Progress," which appeared in the TME of April 1961, are indeed stimulating. American universities should definitely teach the theory of metalcutting including the machinability of materials, tool life, cooling, lubrication, automatic control, determination of machine tool capability, the physics of metalcutting and the limitations of the present metal-forming processes. The stimulation of original research to develop and discover new methods of metal removal in significant quantities should be a prime objective . . .

Dimitri Kececioglu
Director of Reliability
Allis-Chalmers Mfg. Co.

To the Editor:

Strike out the word "American" from the title and the article brings home to one who watches the pace of industrial development in this country how fast and far-reaching can be its effects in every corner of our lives—and how frighteningly little attention is being paid to manufacturing processes by those who run the programs, or by anyone else. Of course, the setting up of four higher technological institutes in this country is indeed a shining event. The universities in India must give thought to the establishment of chairs for the study of machine tools and industrial processes.

K. Janakiraman, Editor
Current Engineering Practice
Bombay, India

To the Editor:

I read with interest the article in the April issue of TME by Dean Drought. It is very significant, I believe, to have educators publicly express these views and point out the needs and opportunities for increasing true scientific knowledge regarding basic manufacturing methods and operations.

The lack of this knowledge in organized form such as textbooks, handbooks and similar reference material has resulted in waste of millions of dollars as the same ground is retraced in plant after plant.

Stimulation of students' interest in the manufacturing field will be a big step forward.

The university-industry team approach made in this article is an extremely practical way to secure the basic knowledge . . .

A. P. Kromer
Varian Associates
Palo Alto, Calif.

To the Editor:

We were delighted to read W. Karl Somers' article "Industry Wants Trained Manufacturing Engineers" in the July issue of TME. It confirms our efforts in this direction . . .

George Feret
Detroit College of Applied Science

. . . product information

To the Editor:

Your Manufacturing Planning Issue (March 15) has been well received by this company. There is only one suggestion that we have to offer for improvement of the Manufacturing Engineering Information Services contained in this issue: why not reinstate the numerical coding system used in the 1959 Suppliers Directory issue? Incorporation of this feature in future issues would simplify the filing of new information into catalog files.

Clarence J. Downie
Chief Engineer
Pacific Car and Foundry Co.

The numerical coding system was used in the 1959 issue as an adjunct to an article, "Filing and Finding Product Information." As such it was both useful and educational. Having accomplished its purpose, it was deemed unnecessary to publish it in subsequent issues. Ed.

. . . research and development

To the Editor:

I would like to say that I concur completely with the editorial in the May issue of TME regarding research and development . . .

B. H. Amstead
Assistant Dean of Engineering
The University of Texas

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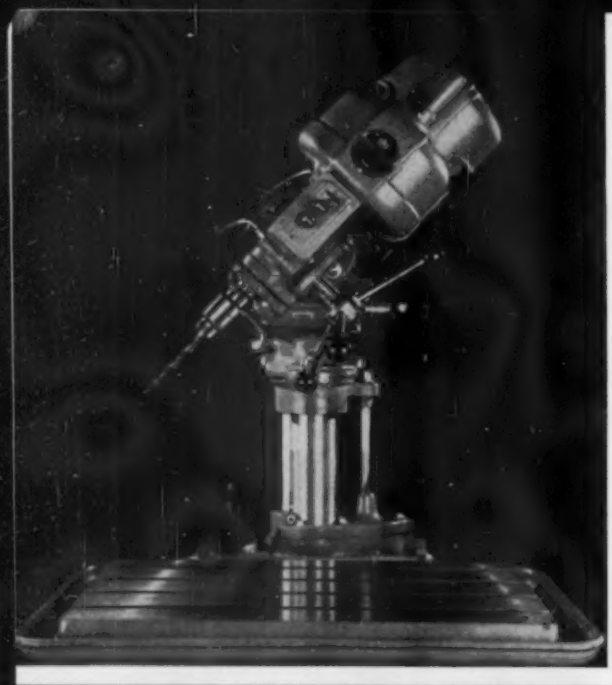

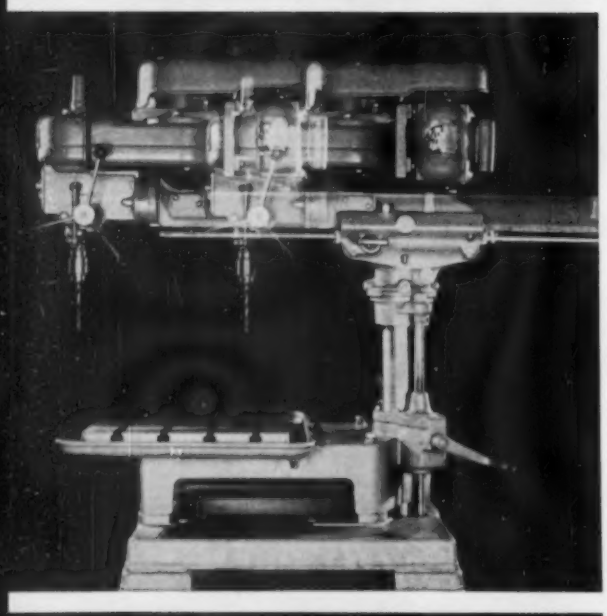

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technical shorts

Space-Age Tool Steel—To help solve one of the more critical problems of Space-Age metallurgy—the machining of super alloys—Continental Copper & Steel has developed and started production of a new type of tool steel that will cut virtually all known alloys and metals. Said to approach the hardness of diamond, the metal has kept its edge up to 10 times as long as previously used standard tool steels. Containing chromium, vanadium, tungsten, molybdenum and cobalt, plus a relatively small percentage (1.15 percent) of carbon, the alloy can be heat-treated and ground by conventional procedures.

Gamma-Ray Inspection—The Rauland Corp., a subsidiary of Zenith Radio Corp., and Picker X-Ray Corp., have developed a new gamma-ray image intensifier system for production inspection of thick steel objects. Used in conjunction with the Picker Orthicon camera and the "Cyclops" cobalt 60 unit, the new Rauland intensifier unit will permit assembly-line inspection of dense material which heretofore could not be inspected with nondestructive testing methods.

Surgery and Jet Engines—Exotic materials developed for high-performance jet engines is proving valuable in prosthetic surgery. A typical example is AMS5385, a cobalt-base alloy equivalent to Stellite 21, which is being used by DePuy Mfg. Co., Warsaw, Ind., in the manufacture of protheses. These are used to replace fractured joints in hip surgery. Investment-cast by Casting Engineers, Chicago, the material's low reactivity makes it impervious to body chemicals.

Breakthrough in Magnets—Development of a new magnetic material, capable of producing a nominal energy product of 7,500,000 gauss-oersteds, has been announced by U. S. Magnet & Alloy Corp. Key to producing the magnetic material is a proprietary process that provides a greater degree of grain orientation through the cross section of the magnet casting. In manufacture, the magnetic crystals of the castings are elongated, permitting alignment of atomic structure in a predetermined direction.

Increasing Press Safety—Elimination of hand or finger exposure in blanking, drawing and stamping operations of power presses is sought through a newly revised American Standard. Approved and published by the American Standards Association, the new standard provides maximum safety procedures through the use of automatic or semiautomatic loading and unloading of dies, the limiting of any point-of-operation opening to a quarter of an inch or, if these methods are not possible, the installation of protective devices to control access to the point of operation.

Point-of-operation devices allowing operator access to the area for loading and unloading dies are to be designed and constructed so that it is impossible for the operator's hands or fingers to remain within the operation area during downward movement of the slide. Devices specified in the standard for this purpose include adjustable press barriers, gates or movable barriers, pull-out sweeps and electronic controls.

Improved Furnace Linings—Low thermal conductivity, improved heat-shock resistance and high-dielectric strength are properties that are combined in a new material for lining induction furnaces. Made of ceramic fiber developed by The Carborundum Co., the liners, designated as T-30, are now being used at Allegheny Ludlum Steel Corp. for the induction heat treatment of steel billets.

Litho Printing of Plastic—A technique for quality printing on sheet plastic by lithography—generally regarded as unsuitable for plastics—has been developed by a British firm. Using special inks and varnish and a new handling process, the system offers an unlimited color range on sheet thicknesses of up to 0.025 inch.

Balancing an Assembly Line—Scientists at Armour Research Foundation have introduced a new method of balancing assembly lines. The technique is adaptable to virtually all type of lines and can be placed in operation by plant engineers and industrial engineers.

To renovate or rebalance a line, the engineer adds up all assembly-stage working times used to make a total unit. He then divides this figure by the number of workers. The number obtained is an average cycle time for each station. Next, he subtracts the actual working time for each operation from the average cycle time. The difference between these figures yields the first clue as to which workers are overloaded, or perhaps not performing to full ability.

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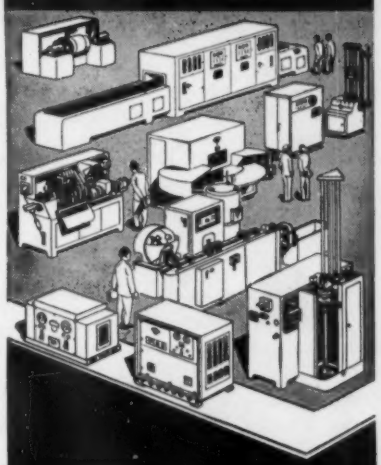

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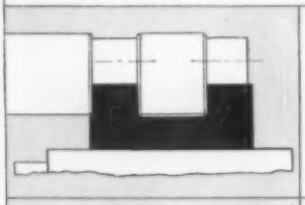
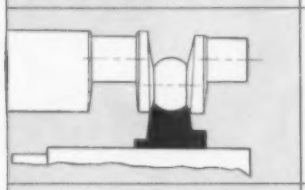
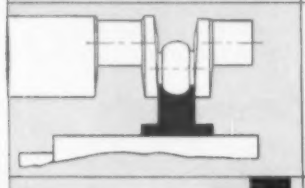
MACHINE TIME . . . 43 seconds
ESTIMATED GROSS PRODUCTION . . . 83 per hour



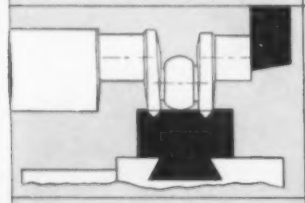
1. Rough eccentric form .550" diameter and 1/32" radius.



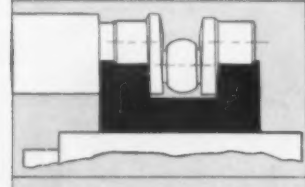
2. Rough eccentric form .643" spherical diameter, finish form inside tapered sides, and 1/32" radius.



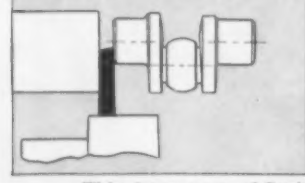
3. Finish eccentric form .643" spherical diameter and .023" radii.



4. Face end. Break corners on 1" diameters.



5. Finish eccentric form .550" diameter, outside tapered sides, 1/64" radii, chamfer 45° on ends, and break-down for cutoff.



6. Cut off.

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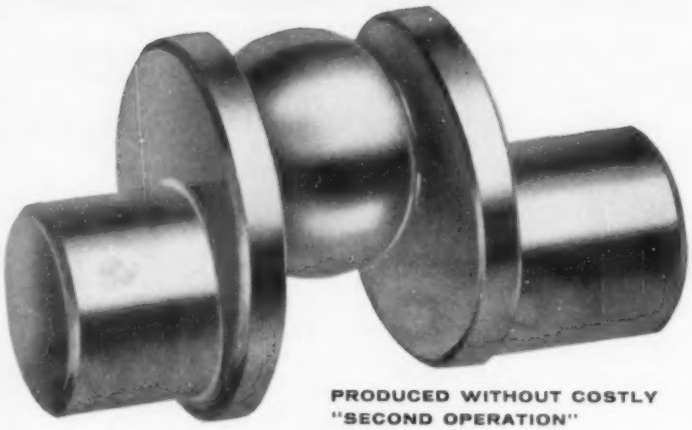

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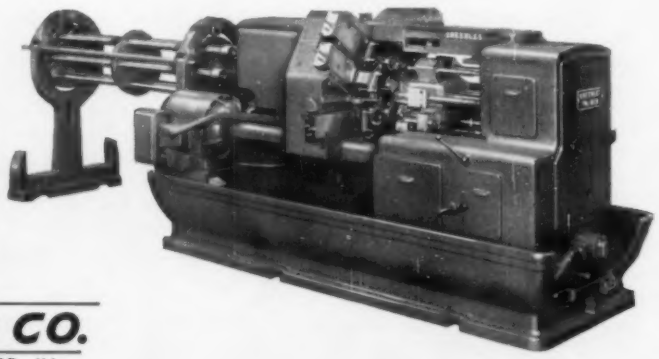

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41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
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341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380
381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400

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421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440
441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460
461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480
481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500

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501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520
521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540
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581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600

TOOL CRIB SECTION INFORMATION

601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620
621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640

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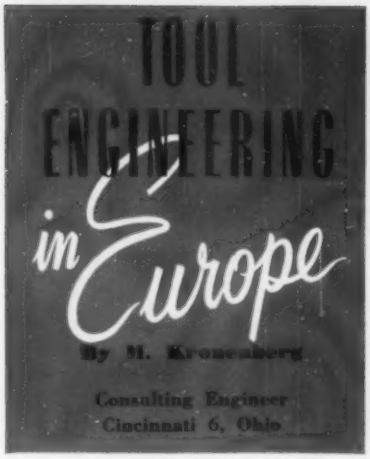

Flame Hardening Temperature Control

Workpiece temperature in flame hardening is difficult to measure and control because it is necessary to penetrate the hot gas flame of about 5400 F to reach the lower temperature (1560 to 2000 F) of the workpiece.

S. Matsuoka of Hiroshima (Japan) has solved the problem with a method described in an article published in *Werkstatt und Betrieb*, Vol. 94, No. 5, 1961, p. 249, "Automatische Temperatur Regelung bei der Vorschub—und Umlauf Vorschub Haertung."

The author first describes the milliscope used in his investigations to measure and control the workpiece temperature. The radiation of a gas differs from that of a solid body, as the gas absorbs and radiates within a certain range of wave lengths but is permeable within other ranges. The milliscope makes use of this property. It incorporates a photoelectric cell highly sensitive within the range of radiant wave lengths, excluding those of the gas. Optical lenses block out the long wave radiation of the gas but pass those that originate in the workpiece. Automatic temperature control of the workpiece is obtained by a feedback system in which the signal picked up by the milliscope controls the speed of the motor driving and feeding the flame-hardening machine.

When the workpiece temperature rises above a preset value, the speed at which the burner advances is increased, and vice versa. The author describes in detail the type of motors used, the problem of overtravel, the need to prevent too rapid temperature changes by selecting a control method with sufficient but not excessive sensitivity to obtain optimum results. Response time must be short to permit fast control of the flame hardening process.

While this method measures flat surfaces easily, it requires special precautions in the flame hardening of gears. The problem has been solved to the author's satisfaction. One example is the prevention of cracks by controlling the temperature at the top of the teeth. With a gear of 6 diametral pitch and a burner capacity of approximately 175 gph cracks occurred when the instrument indicated a temperature of more than 1380 F but were eliminated when the temperature was reduced to between 1200 and 1300 F. In the first case the hardening velocity was 4.3 inches per minute; in the second it was between 5.05 and 5.5 inches per minute.

Machine Tool Motor with Tapered Rotor

The design and operation of a new type of motor for machine tools is described by B. Mursch in *Werkstattstechnik*, Vol. 51, No. 7, 1961, p. 344, under the heading: "Der Verschiebelaeufer Motor als Werkzeugmaschinen Antrieb." The motor looks like any other machine tool motor but the rotor is conical instead of cylindrical and in the author's opinion meets all the requirements of a modern machine tool motor such as stopping accuracy, short overtravel when used as a feed motor, high "stop-start" frequency, frequent reversals of rotation and foolproof operation. The motor is a combination of a drive and a brake. The tapered rotor can move axially, thus increasing or decreasing the gap between rotor and stator, depending on the direction of axial motion. This motion also applies or releases a brake mounted on the shaft. The magnetic forces in the gap can be resolved into an axial and a radial component. The effective axial force depends on the induction in the gap, the size of the gap and the rise of the taper of the rotor.

It is possible to build the motor with two coaxial conical rotors. In this way the speed can be directly reduced to as low as 0.5 rpm. This is a desirable feature in numerically controlled machine tools, when a slow motion (coasting) for say, a table is required for accurate positioning. The main rotor and the slow-motion rotor are connected by a clutch so that the main rotor can be operated without the slow-motion rotor. A built-in thermocouple controls the temperature more accurately than is possible with conventional temperature switches and similar devices.

A thorough mathematical analysis covers power requirements, frequency of speed changes, moment of inertia effects, efficiency, braking power and similar items. One illustration shows a milling machine in which the main spindle motor is also used to brake a flywheel running at high speeds at the instant when the milling cutter is disengaged from the work, with considerable savings in idling time and tool breakage.

On the same machine, the feed drive is also equipped with a conical rotor motor for fast stopping of the feed and high positioning accuracy. In one instance braking time is 0.33 sec and overall overtravel time, 0.392 sec. As milling machine spindle speed is 1000 rpm, only 6½ revolutions are required to stop the motor. Error is ±0.2 revolutions.

Tool Engineering in Czechoslovakia

Life of twist drills is increased 100 percent and higher torques can be used with twist drills manufactured by hot forming. The hot forming method is described by F. Hradzil in "T.Z. fuer praktische Metallbearbeitung," Vol. 55, No. 6, 1961, p. 285, in a review of the development of chipless machining processes in Czechoslovakia appearing under the title, "Stand der spanlosen Formung in der CSR."

Test units were made by hammer forging twist drills of 0.4-inch diam in two steps. The blanks were heated by passing an electrical current through them for about 8 seconds, resulting in a straight profile. After reheating, the helix was produced by twisting the blanks in a special fixture. Points and cutting edges were ground in the conventional way. For comparison, drills were made from the same batch of blanks by the conventional milling process.

For larger scale production of the same size drills, rods of high-speed steel 0.31-inch diam were used. The cross section was reduced in three steps and a special rolling mill was designed for a rolling speed of about 70 fpm.

Other topics covered in the article include extrusion of metals, thread rolling, bending of thin walled tubes, radial pressing of milling cutters and other tools, precision forging of gears, rolling of rings.

Burnishing for Surface Finish

The surface finish produced by burnishing depends on initial surface roughness, hardness, forces applied, diameter of the surface to be machined, roller diameter, radius of the roller, feed and number of passes, and requires therefore a careful balancing of these various factors. V. M. Braslavskii has investigated these problems and reports on them in *Stanki i Instrument*," translated into English in *Machine and Tooling*, Vol. 32, No. 1, 1961, p. 12. The title of the article is "Roller Burnishing

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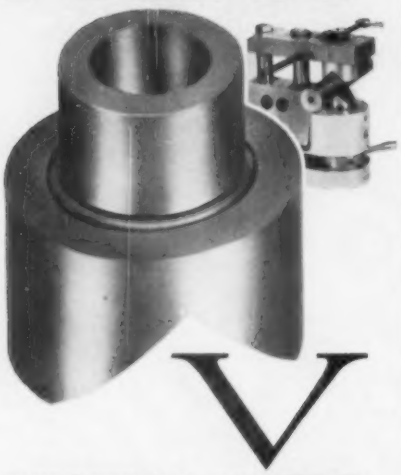

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Tool Engineering in Europe

of Steel Components." The author finds that stresses and deformations in the metal under the burnishing roll are similar to those that occur in brinelling. He applies the Meyer formula, associating brinelling force and impression diameter to the burnishing of a cylindrical workpiece with a round roller where an elliptical rather than a round impression is produced.

Mathematical relationships are derived and shown in a diagram correlating roller diameter, workpiece diameter (outside and inside), roller radius in axial direction and burnishing force, for the case of a steel identified as Steel 20. For other steels correction factors are tabulated.

The author presents details for different classes of surface finish in terms of the Russian standard classifications and indicates that his theoretical derivations have been experimentally verified by him. The feed and the number of passes depend on the radius of curvature of the roller in axial section, the number of rollers in the attachment, etc. In most cases one pass is sufficient to produce the surface finish; second and third passes are specified when the initial surface roughness is of Class 4. Surface finish is increased by four to six classes when burnishing without roller feed. This, however, is possible only in a limited number of cases (fillets, etc.)

Determination of Tool Wear

American practice measures tool life by flank wear—a tool is considered dull when the flank wear exceeds 0.030 inch for high-speed steel tools, or 0.015 inch for carbide tools. European tool engineers include the formation of a crater on the tool face in the criteria for judging tool life.

Difficulties associated with measuring flank and face wear are discussed in an article, "Bestimmung der Kolkverschleiss daten und der Kantenversetzung aus Leitz-Foster Diagrammen," published by A. Schepers and E. V. Blumenstein in *Werkstattstechnik*, Vol. 51, No. 7, 1961, p. 335.

These diagrams are actually shadowgraphs of the tool profile, before and after a machining operation. The cutting edge is very difficult to locate on the tool after the tool has been used. The authors ask themselves three questions: "Where is the cutting edge located after wear?" "How can the displacement be measured?" "Where is the cutting edge in case of a built-up edge?" They have developed several methods to answer these questions, but are not able to determine the location of the cutting edge in the case of a

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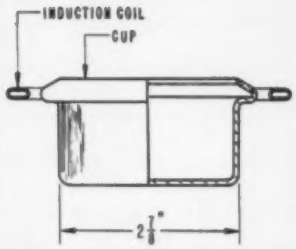

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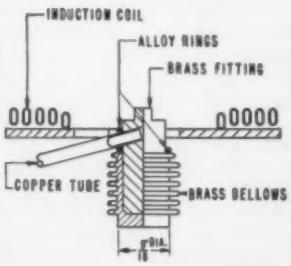

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Tool Engineering in Europe

built-up edge. In these cases, therefore, it is not possible to determine tool wear, i.e. the depth and distance of the crater on the tool face and the wear of the tool flank.

The tests were limited to high-speed steel tools and would not necessarily be duplicated in case of carbide tools because built-up edges appear less frequently on them. We may add that differences in published tool life data are often due to the difficulty of determining the wear of the tool; in high-speed steel tools the burnishing effect on the workpiece is often taken as indicating the end of the tool life. A better method for determining tool wear is therefore desirable.

Abrasive Belt Grinding

Abrasive belt grinding is an efficient machining method when mineral oil with oleic additive is used for lubrication, according to S. M. Kedrov, writing in *Stanki i Instrument*. An English translation of his article appears in *Machines and Tooling*, Vol. 31, No. 10, p. 11-15. The title of the article is: "Investigating the Abrasive Belt Cylindrical Grinding Process."

Tests were run on a cylindrical grinder and a centerless grinder. The grinding wheels were replaced by abrasive belts held under tension by devices described in the article. The mean metal-removal rate in grams per minute and the specific metal-removal rate in grams per kilowatt-minute, as well as the surface finish, were employed as criteria for comparison of the effectiveness of various lubricants and for testing the dry grinding process.

In dry grinding with a belt speed of 114 fps, the metal-removal rate dropped rapidly with time—from 1.12 oz-min initially to 0.70 oz-min in the twelfth minute. Use of a lubricant identified as Spindle Oil No. 2 kept the metal-removal rate nearly constant, due to the effect of the oil on both the work surface and the belt. With lubricant, the belt remains more elastic and retains the abrasive layer better.

The author added various amounts of oleic acid to the oil (from 0.5 percent up to 3 percent) and found that adding more than 1 percent of the acid does not improve the metal-removal rate above that of a 1 percent addition. His investigations were extended to include sulfurized oil with various amounts of acid. The effect of grain size was likewise studied. Grain sizes from 36 to 240 in five increments were tested. Emery cloth with a 36 grain size lost its productive capacity quickly in comparison with belts having 46 to 60 size grains.

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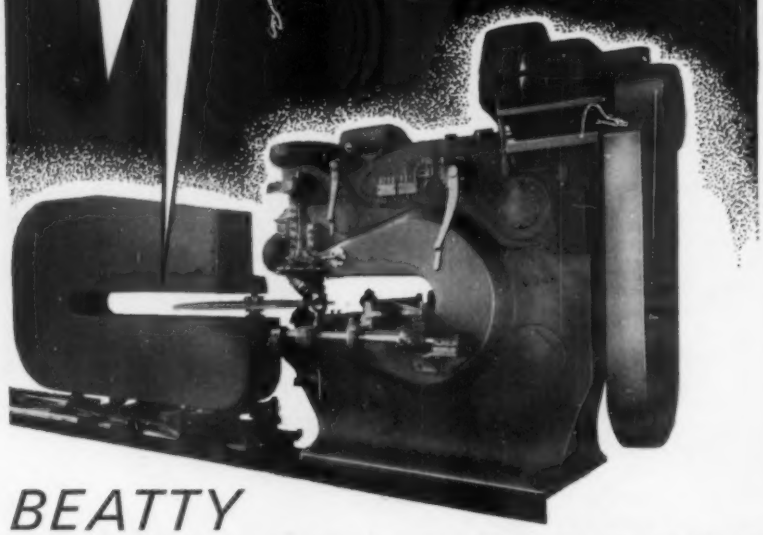

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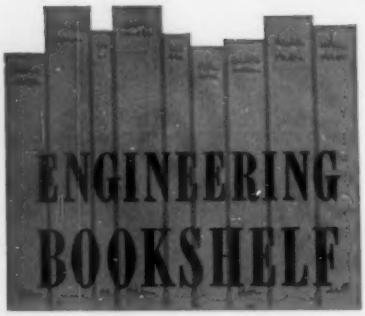

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Because industrial building has been without an exclusive medium of information, this book fills a significant need in modern technical literature. Containing the *Proceedings* of the Industrial Building Congress, it discusses optimum facilities, modernization of older buildings, architecture, and problems of finance and cost control during construction. These subjects are treated in detail by men actively engaged in all phases of construction.

MANAGEMENT PROBLEMS IN THE ACQUISITION OF SPECIAL AUTOMATIC EQUIPMENT—*By Powell Niland. Harvard Business School. Price $5. 336 pages.*

This book discusses new policies and procedures in the acquisition of special automatic equipment. Steps in the acquisition process from the first one—the development of ideas—to the final one—acceptance of the finished equipment by production departments—have been analyzed for problem areas. This study suggests methods whereby management can minimize the difficulties inherent in these areas. Although this book discusses engineering, it is written primarily for top management.

TOOL STEEL SIMPLIFIED—*By Frank R. Palmer and George V. Luerssen. Carpenter Steel Co. Price $2.50. 595 pages.*

Analyses, characteristics, types and use of tool steels are discussed. Attention is given to problems of heat treatment arising not only from the type of steel selected, but from the tool design as well. Ample use of charts, graphs and conversion tables makes this a useful reference book.

PLASTICS ENGINEERING HANDBOOK, *3rd Edition. Reinhold Publishing Corp. Price $10. 362 pages.*

Compiled by The Society of the Plastics Industry, Inc., this book covers virtually all types of plastic materials and methods of fabrication. These include: extrusion techniques; compression, cold and transfer molding; and standards. Tool and manufacturing engineers will find the chapters on tooling and die design especially useful if their work involves the use of plastics.

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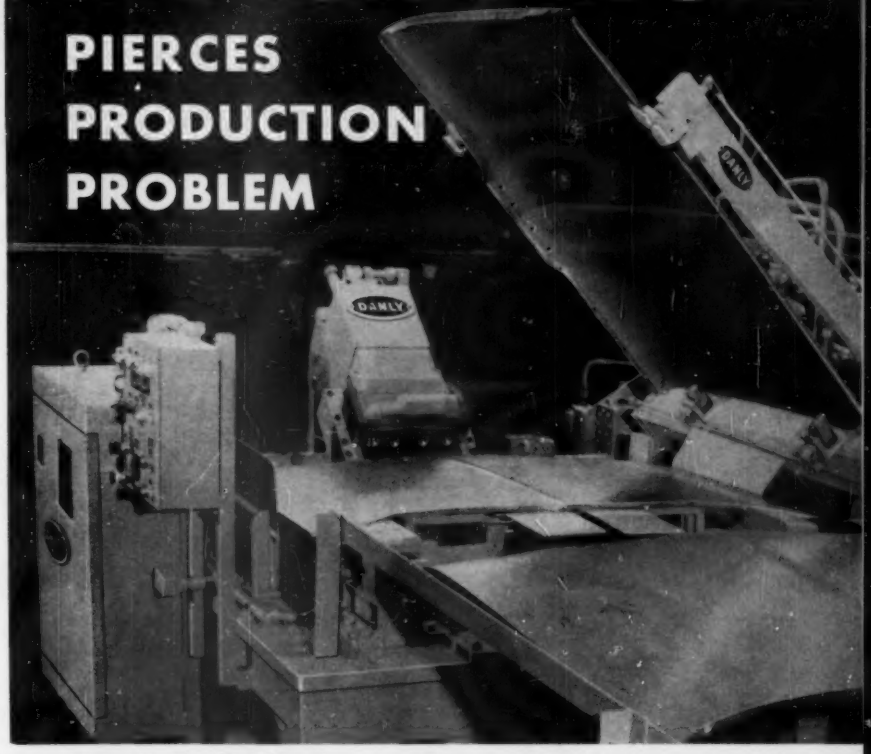

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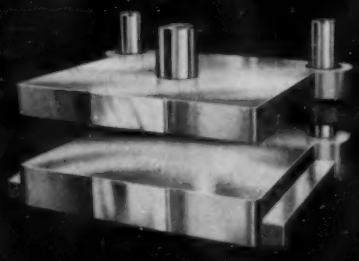

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Trade Literature

for free booklets and catalogs—use request card, page 169

TITLES OF OVER 300 translated Russian articles published in 10 different technical journals are listed in an index. For a copy write to I. Flohr, Primary Sources, 11 Bleecker St., New York 12, N. Y. . . . One feature of a recording and reproducing instrument is its solid state signal electronic system with a fourth generation transport. Ampex Corp. **(Circle 501)** . . . Four miniature power tools and a line of miniature hand pieces for grinding, deburring, drilling, sanding, polishing and cutting are described in a catalog. Another unit converts standard drill presses, electric drills and motors into miniature power tools which can be operated at speeds from 1500 to 10,000 rpm. Foredom Electric Co., Inc. **(Circle 502)** . . . A new method for determining how well a compressed air filter is working involves introducing a mist of oil into the air entering the filter with a lubricator and releasing the filtered air from a tube into a beam of light from a projector. Against a dark background, oil mist in the cone of air leaving the tube is highly visible. The performance of the filter can be judged by comparing the size and brightness of this outlet cone with that obtained using unfiltered air taken directly from the lubricator. King Engineering Corp. **(Circle 503)**

Automation, Mechanization

Add-subtract digital process controllers provide direct reading numerical indication of bidirectional counting or measuring operations and also actuate automatic machine control functions. Dynapar Corp. **(Circle 504)** . . . Simple pencil line sketches of intricate shapes and forms can be used to guide oxygen shape cutting machines with an electronic tracer. Linde Co. **(Circle 505)**

Boring, Drilling, Tapping

High-speed automatic drilling and tapping units have almost no reciprocating friction and will reciprocate on low air pressures to permit floating cushion action of the spindle. This—because it allows the tap to feed itself—eliminates distorted threads and lead error. Hypneumat, Inc. **(Circle 506)** . . . Included in a bulletin covering various types of reamers are tips and rules for obtaining maximum efficiency and life. Precision Twist Drill & Machine Co. **(Circle 507)** . . . A single-end boring machine can be used for semi-finishing operations in addition to finish-boring, facing, chamfering, grooving, gun-drilling and bore-reaming operations. Olofsson Corp. **(Circle 508)**

Cleaning, Painting, Plating

The latest addition to a line of anodes, anode accessories and chemicals for electroplating and metal finishing is a titanium anode basket. Hanson-Van Winkle-Munning Co. **(Circle 509)** . . . A 24-page handbook discusses 40 finishing operations where costs can be cut by wet blasting. Lord Chemical Corp. **(Circle 510)**

Cutting Tools

Reamers, end mills, counterbores, toolbits and cutoff blades are described in a 48-page catalog. Besly-Welles Corp. **(Circle 511)** . . . A catalog covers an entire line of end mill and die sinking cutters. Tomkins-Johnson Co. **(Circle 512)** . . . A tap users' guide, trouble shooting section, resharpening instructions and tables on thread constants, Acme threads and drill diameters are included in a tap catalog and tapping handbook. Besly-Welles. **(Circle 513)**

Electric Motors, Controls, Drives

"Design or Modernize Heavy-Duty Grinding Mills" pinpoints cost-saving potentials of air-actuated clutches used in grinding mill drives. Fawick Airflex Div. **(Circle 514)** . . . A new 10-amp, 300-volt industrial relay is designed to cut control panel space requirements. General Electric Co. **(Circle 515)** . . . Typical applications of small, zinc alloy, one-piece gear and pinion combinations include business machines, speed reducers and meter counters. Gries Reproducer Corp. **(Circle 516)** . . . A line of general purpose integral horsepower motors is described in a 6-page bulletin. Kingston-Conley, Inc. **(Circle 517)**

Fastening, Joining

"Fastener Value Analysis" not only explains techniques for evaluating metal fasteners in terms of their use but also cites specific examples of product improvements that have resulted from such analysis. H. M. Harper Co. **(Circle 518)** . . . A 12-page booklet on expansion fitting as a time-saving, reliable assembly procedure contains a case history along with photographs illustrating expansion-fitting bearing raceways. Cincinnati Sub-Zero Products. **(Circle 519)**

Finishing, Grinding

"Diamond Grit Performance: Some New Evaluation Results" points out that selecting the correct grit and achieving higher levels of performance require consideration of many variables not relevant when there was only one type of diamond grit available. Industrial Diamond Div., Engelhard Hanovia, Inc. **(Circle 520)** . . . In addition to describing liquid and bar compounds for automatic and manual buffing and polishing operations, a bulletin discusses compounds for finishing hard rubber and plastic products. Hanson-Van Winkle-Munning Co. **(Circle 521)** . . . For a copy of "American Standard Specifications for Shapes and Sizes of Diamond Grinding Wheels, Hand Hones and Mounted Wheels, B74.3-1961," write to the Grinding Wheel Institute, 2130 Keith Bldg., Cleveland 15, Ohio . . . A 6-page catalog covers two types of surface grinders. Thompson Grinder Co. **(Circle 522)** . . . Data given in a 20-page manual includes finish selection, appearance and characteristics, and production factors affecting different surface finishes. Lea Manufacturing Co. **(Circle 523)** . . . Diamond particles held in position with a powdered metal matrix give cemented diamond dressing tools added tool and wheel life and improved performance. Koebel Diamond Tool Co. **(Circle 524)** . . . A 12-page booklet, which gives primary attention to a new drill pointer, provides technical information on machines for wet and dry grinding. Oliver Instrument Co. **(Circle 525)**

Fluid Power

Eight fluid drives and 11 couplings are listed for fractional to 1000-hp require-

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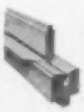
25 TON HYDRAULIC PRESS BRAKE

It takes less than 15 seconds to preset the length of stroke for most efficient operation and maximum safety. The rapid, dual speed work cycle provides fast approach, slow work and fast return—or a stroke as slow as 6 operations per minute. It's easy to "inch" the ram or reverse it at any point in the stroke. Dangerous sheet whipping with resultant costly kinking can be virtually eliminated. This dependable 25 ton hydraulic press brake is available in 6 and 8 foot bed sizes.

Designed for high speed, economical forming and fabricating of small parts. The 12 Ton series uses standard press dies and is practical for short run production and sample work. Available with 3 or 4 foot bed.

A complete selection of press brake dies for bending, blanking, box forming, corrugating, curling, hemming, punching and flattening. Fits all standard press brakes.



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Trade Literature

ments, together with actual installation photographs, product pictures and engineering drawings, in a 20-page bulletin. Dodge Manufacturing Corp. **(Circle 526)** . . . A 48-page digest describes a line of air and hydraulic control products for automating in-plant operations and for component use. A. Schrader's Son, Div. of Scovill Manufacturing Co. **(Circle 527)** . . . Solenoid-operated fluid power pilot valves handle pressures to 3000 psi. Oilgear Co. **(Circle 528)** . . . A new 1⅛-inch clamp type 150-psi air or 250-psi hydraulic cylinder with universal, clevis, pivot or stud mounting, and a solenoid-operated cylinder are described in a bulletin. Sheffer Corp. **(Circle 529)**

Heat-Treating

Automatic control for open hearth furnaces, glass tanks, reheating and annealing furnaces and soaking pits is discussed in detail in a 24-page booklet. Both hydraulic and electrohydraulic type of systems and various control subsystems are covered. GPE Controls, Inc. **(Circle 530)** . . . Hardening, annealing, normalizing and preheating are among the applications of a box type furnace. Sunbeam Equipment Corp. **(Circle 531)** . . . Tagliaferri furnaces use a controlled stirring action to produce an homogenized, fine-grained metal of high strength and ductility. Corrections for analysis can be made in the furnace. Hevi-Duty Electric Co. **(Circle 532)**

Inspection, Measurement

Solutions to many common problems in gaging diameters, depths, grooves and angles are given in the second edition of "Ideas." Boice Gages, Inc. **(Circle 533)** . . . Steps for the proper care and inspection of horizontal and vertical dial indicators are pointed out in a bulletin for inspectors and quality control men. Dwight Instrument Co. **(Circle 534)** . . . A new checking system graphically helps isolate tooth spacing errors in straight or helical gears and splines by measuring pitch line runout and eliminating its effect on an index check. Michigan Tool Co. **(Circle 535)** . . . A 4-page folder describes methods for establishing consistent standards for power-wrench accuracy in addition to listing various torque tension testers. Skidmore-Wilhelm Manufacturing Co. **(Circle 536)** . . . Two applications of sensing devices are measuring strip steel and feeding data to a logger and providing beta ray measuring equipment on high-speed production lines. Designers for Industry. **(Circle 537)**

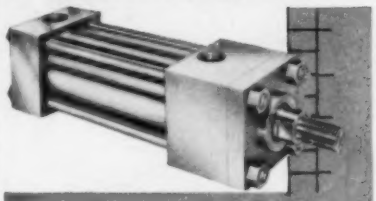
Lathes

Both heavy turning and delicate work

(Continued on Page 181)

NEW O-M SQUARE-HEAD AIR AND HYDRAULIC CYLINDERS

GIVE THE PERFORMANCE YOU EXPECT... AND MORE



Air—(rated 200 psi)
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Meet JIC Standards 1½" to 14" Bores

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Made of the highest quality materials and seals, these new components combine modern design, the latest and best engineering advancements with O-M specialized "know how" and precision workmanship.

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Construction features include brass cylinder barrel, chrome-plated, high tensile steel piston rod with a minimum yield strength of 90,000 to 100,000 psi. Rolled and machined steel heads and extra long cartridge-type rod bearing assure perfect alignment of piston rod.

New Series "L" Hydraulic Cylinders

Similar in many construction features to Series "K", but specifically designed for hydraulic service. Incorporate vee-type rod packing and a cylinder barrel of micro-honed steel tubing which are best suited for hydraulic operations.

With the addition of the new Series "K" and "L" to the Ortman-Miller major line of air and hydraulic cylinders, you can now rely on O-M for *all* of your low and medium pressure cylinder requirements.

Mail coupon today for complete details. All cylinders in Bulletins 115A and 116 have been dimensioned in accordance with NFPA recommendations for your convenience.

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Please send Bulletin(s)
☐ 115A—Series "K" ☐ 116—Series "L"

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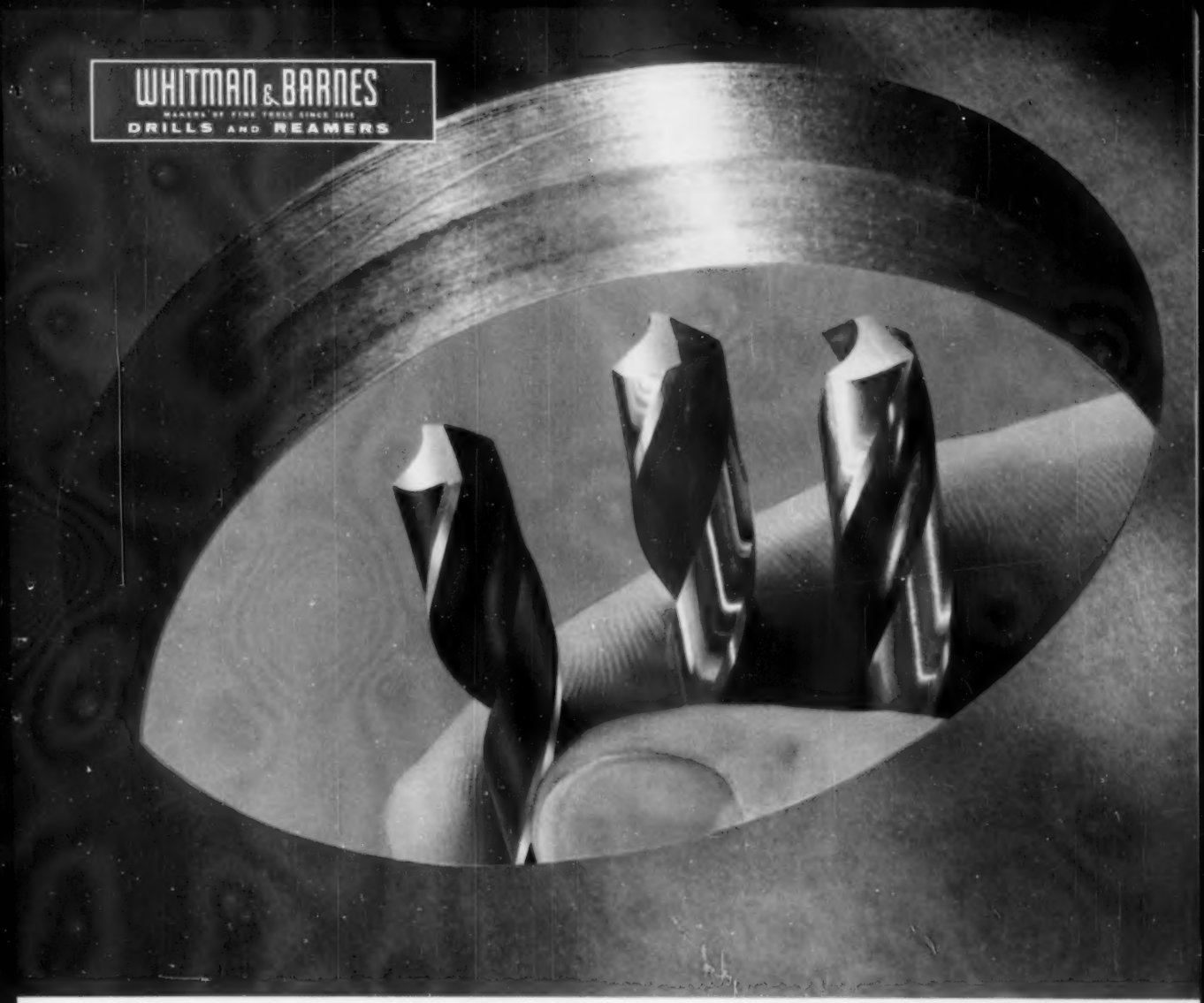

which drill really costs less?

Based on results, drills "A" and "B" (center and right, above) should cost 43% and 39% less than W & B drills (left, above)—instead, they can be purchased at *only* about 20% less.

Watch those *initial* costs—they may be *costly!*

COMPARATIVE DRILLING PERFORMANCE

General Purpose Jobbers Drills	*No. of holes per drill size					Total No. of Holes	Efficiency Rating
	#40	#30	5/16"	1/4"	3/8"		
W & B Drills	208	62	57	50	34	411	100%
"A" Drills	142	24	14	28	28	236	57%
"B" Drills	114	49	13	61	15	252	61%
Thickness of plate	9/32"	3/8"	1/2"	1"	1"	Material: Heat treated chrome nickel steel	

**In each drill size, five drills of each brand were tested and each drill was resharpened three times as required.*

W&B

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Many drill performance tests similar to this one have been made. However, W & B will gladly conduct drill tests at *your* plant and under *your* conditions. Contact us direct or through your W & B distributor. He can offer this service plus fast delivery from complete stocks.

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Automatic Punch Riveters to meet your every need: from the 3" Throat portable model for hard-to-reach work areas, to 48" Throat model for large and irregular assemblies.

ARE YOU RIVETING (OR WELDING) YOUR PROFITS AWAY?

Then consider the advantages of "One Man-One Machine" operation with ACF-ERCO Automatic Punch Riveters: **1.** Operate at speeds up to 45 rivets per minute—4 to 11 times faster than other metal fastening tools or techniques. **2.** Reduce handling and die work—reduce scrap completely. **3.** Liberate up to 80% of existing manpower. **4.** Improve product strength and quality—reduce costly inspection. **5.** Increase consistency and uniformity of output. **6.** Pneumatically-powered, electrically controlled, human-engineered for maximum operator efficiency.

For specifications, free brochure or information on how ACF-ERCO Automatic Punch Riveters can achieve man-hour economies as high as 90% for you—write: ACF-ERCO Machine Tools, ACF Electronics Div., Riverdale, Maryland.

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DIVISION

ACF INDUSTRIES

can be done with a line of 40-hp heavy duty engine and toolroom lathes. R. K. LeBlond Machine Tool Co. **(Circle 538)**

Lubricants, Coolants

A 16-page brochure outlines 60 different kinds of industrial lubricants and a program to streamline lubrication programs and cut costs. Pure Oil Co. **(Circle 539)**

Materials

Forty-two bronze alloys and heat-treated variations are described in a bulletin. Ampco Metal, Inc. **(Circle 540)** . . . Among the new data given in the fourth edition of a handbook is a simplified approach to the selection of flexible shafting. S. S. White Industrial Div. **(Circle 541)** . . . The history of beryllium to date as a structural material; the economics of weight in spacecraft parts; and the physical characteristics of beryllium are reviewed in a booklet. Standard Pressed Steel Co. **(Circle 542)** . . . A paper entitled "Heat Treatable Steel-Bonded Carbides," presented at the 16th annual meeting of the Metal Powder Industries Federation, discusses significant physical and mechanical properties of Ferro-Tic C carbide. Sintercast Div., Chromalloy Corp. **(Circle 543)** . . . Information on copper-base, stainless steel and nickel-base alloys is given in a file folder. H. K. Porter Co., Inc. **(Circle 544)** . . . Technical information and typical applications are given in a handbook on brass wire, rod and strip. H. K. Porter Co., Inc. **(Circle 545)** . . . "The Story of Cold Finished Steel Bars" —a 69-page, hard-back book by Fred J. Robbins—is available by writing on company letterhead to Sierra Drawn Steel Div., Bliss & Laughlin, Inc., Harvey, Ill.

Pressworking

Three series of mechanical press brakes have capacities of 50, 65 and 90 tons with bed and ram lengths ranging from 72 to 168 inches. Verson Allsteel Press Co. **(Circle 546)** . . . Suggestions on standardization, cost-cutting and purchasing procedures are included in a catalog covering a line of punches and dies. Dayton Perforators, Inc. **(Circle 547)** . . . Advantages of thread rolling are enumerated in a bulletin covering bump, straddle and plunger and through-feed type thread rolls. Detroit Tap & Tool Co. **(Circle 548)**

Welding, Brazing, Soldering

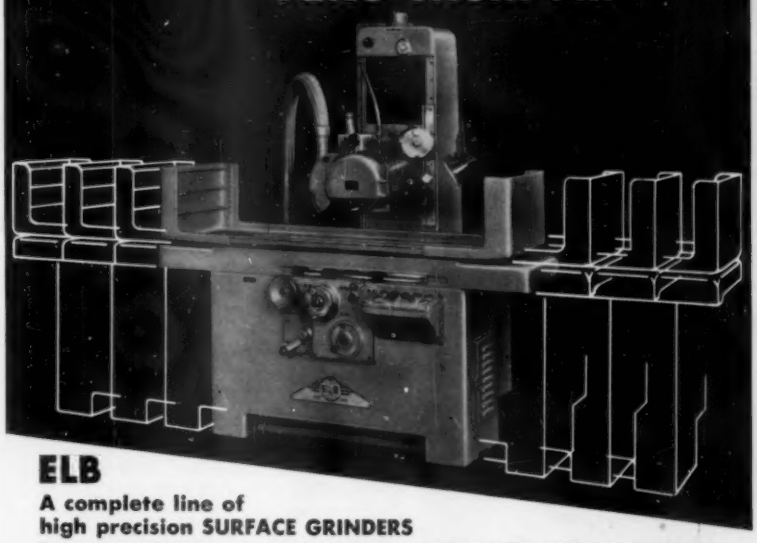
An electric welding library contains process and application details on short arc welding, mixing and TIG welding and spot welding; submerged arc welding, CO_2-flux arc welding; and plasma arc cutting, welding and weld surfacing. A list of these papers is available from Linde Co., 270 Park Ave., New York 17, N. Y.

Workholders, Fixtures

Internal chucking within 0.0005 inch TIR is possible with a line of expanding mandrels. Erickson Tool Co. **(Circle 549)** . . . High-speed steel and carbide countersinks and a resharpening fixture are described in a bulletin. M. A. Ford Mfg. Co., Inc. **(Circle 550)** . . . "Precision Granite Surface Plates and Straight Edges" gives reasons for selecting granite when nonmagnetic, suction-free, rustproof, warp resistant, temperature resistant and nonabrasive qualities are required. A. Ottavino Co. **(Circle 551)** . . . A catalog describes equipment and methods for performing form relief grinding on various cutting tools. R-O Manufacturing Co. **(Circle 552)** . . . Adjustable drawkeys which use an expanding plunger to draw Morse taper shank tools firmly into the machine spindle prevent damage to tools and spindle and loss of machining accuracy caused by hammering tools or a solid drawkey into the spindle. Giddings & Lewis Machine Tool Co. **(Circle 553)**

Grinding Jobs Large or Small

ELB Tables Take Them All



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A complete line of high precision SURFACE GRINDERS

Your choice of 35 models, ranging from 6" x 12" x 7¾" to 59" x 197" x 39½". Models with proportionately wide tables, especially suited for tool and die work are available; these machines are capable of taking almost any grinding job, regardless of size.

Model	Grinding Width	Grinding Length
Jewel	6"	12"
Brilliant	10"	18"
S W	12"	24"-47"
S W B	20"	24"-197"
S W D	25½"	59"-197"
S F	29½"	79"-197"

ELB features:

• Fully automatic work cycle • Easy operation • Functional design • Increased output due to widest cross feeds (up to 2⅜" per table stroke) • Profile grinding with 4" wide grinding wheel • Automatic copying grinding • Automatic sizing equipment • Automatic return of wheelhead to starting position.

See these and other Alina machine tools at fully equipped showrooms in: Chicago, Ill. • Detroit, Mich. • Los Angeles, Calif. • Philadelphia, Pa. San Francisco, Calif. • Seattle, Wash.

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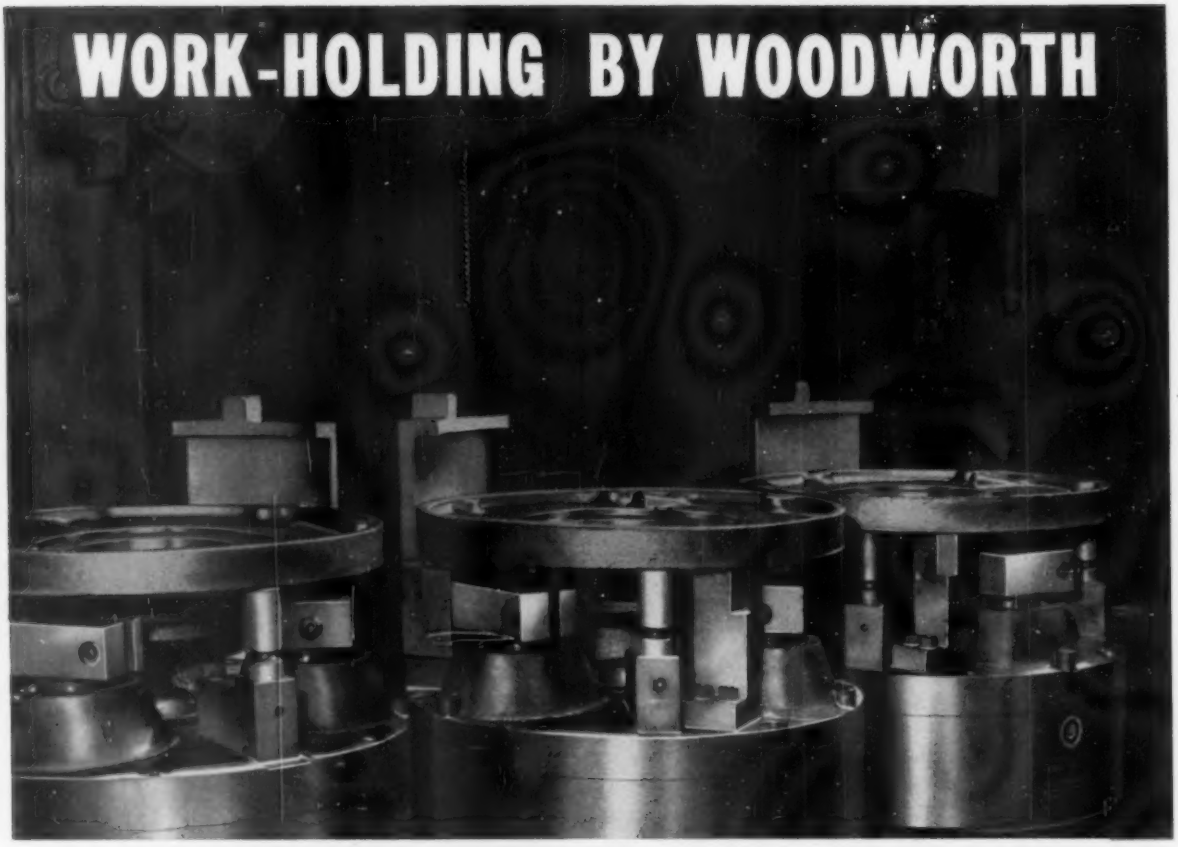
WORK-HOLDING BY WOODWORTH



CHRYSLER TOOLS NEW TRANSMISSION WITH 96 WOODWORTH "BALL-LOK" CHUCKS

WILLIAM BOLLINGER

● **WILLIAM BOLLINGER,** *Tool Engineer, Chrysler Corporation Transmission Plant in Kokomo, Indiana, reports on the performance of WOODWORTH "BALL-LOK" CHUCKS: "In January, 1961, we installed and have had in operation a total of* **ninety-six** *"BALL-LOK" CHUCKS used in machining five different transmission parts. On the particular job pictured above the "BALL-LOK" power chuck's pull-back action permits the part to be located positively against the flange face which minimizes the amount of stock necessary in the original casting. The machine can also be operated at approximately one-half of the hydraulic pressure formerly needed when sliding jaw types of chucks were used, which, of course, results in lower maintenance costs. The sealed mechanism of the "BALL-LOK" design and the lack of friction has resulted in absolutely no maintenance to date."*

● Illustrated above is just one of the jobs at Chrysler's Transmission Plant. Sixteen 11¼" external "BALL-LOK" CHUCKS are installed on a Model L Bullard for machining front oil pump housings. The material is cast iron and is chucked on an O.D. of 3.60 with radial locators for eccentric boring. Three diameters are bored with a maximum stock removal of .170. Tolerances are held on the small bore to ±.0005. The maximum surface speed is 280 feet per minute and .025 feed per revolution.

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ACCURACY YOU CAN TRUST

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Tech Digests

Selecting Power-Press Drives

Press design improvement, particularly in the application of air friction clutches and brakes, has enabled press manufacturers to apply variable speed drives to their fullest capabilities. The principal need for variable speed arises from the problem of feeding strip stock into presses. Here, coil stock is automatically fed into the die area during the upper 180 deg of crank travel. Approximately six inches of stock is fed into the press at each stroke.

Since the maximum rate of speed in feet of stock per minute is practically constant, maximum production is maintained when the number of press cycles per minute is inversely proportional to the feed length per cycle. Stated another way, the press can operate at twice the hits per minute on one part, as compared to another part requiring twice the feed length of the first. Therefore, when feed length is the determining factor, variable speed is necessary for peak production.

In many instances, it appears that a die will run best at a given speed, while a similar die may have a slightly different optimum speed, irrespective of maximum feed rates. At other times, particularly with a new die, it is helpful to run the press at a low speed during the break-in period. Lower than normal speeds are also required when coil stock is started through the various stages of a progressive die. Because of these variations in speed requirements, variable-speed drives are mandatory in modern presses.

Variable-speed drives can be separated into two types—electrical and mechanical. The latter includes the common spring loaded sheave with flat belt which requires variable flywheel-to-sheave distance. In addition, the mechanical variable speed package uses much the same principle except that two variable pitch intermediate sheaves maintain constant center-to-center distance. The package drive is far more convenient to use than the variable pitch sheave alone because it offers wider speed range, a variety of mounting arrangements and accessories including electric remote control of speed and tachometer indication of speed.

Ordinary d-c motors are often used for electrical drives. However, most users do not have a d-c bus. Even in plants where a d-c bus exists, it may not reach the press area. In some cases, spare capacity may not be available for press drives. Thus, it is necessary to use an auxiliary power supply, either rotary or static. If capacity is available, the d-c motor may provide satisfactory operation over a two-to-one speed range at an economical price for electrical drives. However, if d-c bus capacity is increased or auxiliary power supplies employed, the over-all price is uneconomical for serious consideration.

The most popular of electrical drives is the eddy current coupling type. This is an a-c induction motor driving a d-c exciting eddy current coupling with feedback from the output shaft. This system provides a preset speed which is maintained with good regulation. Its one disadvantage is the low-electrical efficiency at low speeds, a factor which is normally of small consequence.

From a paper "Electrical Drives for Power Press Applications," by Robert D. Jordan, The Minster Machine Co., Minster, Ohio, presented at the 25th Annual Machine Tool Electrification Forum, sponsored by the Westinghouse Electric Corp., Pittsburgh, Pa.

Increasing Missile Reliability

A study of rocket engine reliability growth curves reveals several important facts. The time required to reach reliability levels in excess of 90 percent has progressively decreased over the years. Redstone engines required four years of development before reliability began to level off. Navaho engines reaches this status in three years. More recent engines such as the Jupiter, Thor, and Atlas attained the higher reliabilities after 1½ to 2 years of development. As a result of advancements in the state of the art, there is every reason to believe that this trend will continue in the near future.

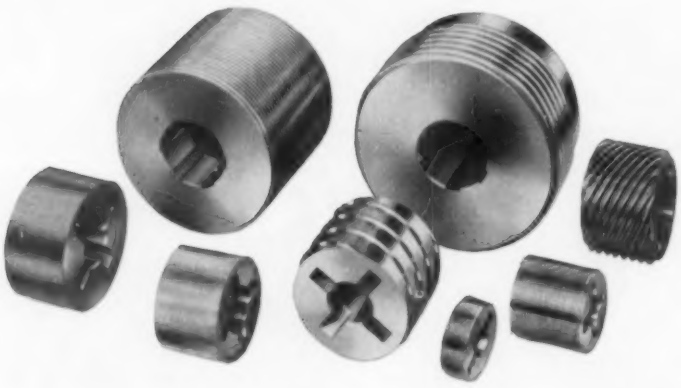
With the present conventional engine designs and philosophy, it would appear that reliabilities in the order of 94 to 98 percent may be expected on single-thrust-chamber engines in the near future. Limiting factors appear to be associated with design philosophy and the number of components employed. Reliabilities of 99 percent and over, mandatory on future engines, will require some major breakthrough in design or concept. A trend toward fewer components and simplified operation—typical of Rocketdyne's more advanced engines—may provide the necessary step for approaching high reliability.

Two additional areas wherein improvements may be attained in the near future are structural integrity of the engine and the gas generator system. With the availability of materials with a high strength-to-weight ratio, such as Inconel-X for thrust chamber tubes and Rene 41 for turbine rotor forgings, higher design margins can be achieved. Reoriented rocket engine design in the direction of man-rated engines and away from high thrust-to-engine weight ratios is a necessary change in philosophy for space missions.

At a recent American Rocket Society meeting, a Rocketdyne paper outlined how the gas generator system may be eliminated. An Atlas MA-2 sustainer engine was altered and tested to establish the feasibility of the approach. In the experiment a solid-grain cartridge was used to spin the turbine and combustion products were bled from a relatively low-temperature area of the chamber. Turbine power was thus supplied by bootstrap operation.

Through elimination of the need for precise flow control and sequencing, injection, ignition, and plumbing associated with the more conventional gas generator system, about one-half the remaining potential problems are eliminated. Although a quantitative measure

More Can Be Done



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is nonexistent at this time, significant reliability gains can be predicted on the basis of the exclusion of five components, eight static seals and all dynamic seals.

From a paper "Future Reliability Concepts and Ramifications," by B. H. Hershkowitz, North American Aviation, Inc., Downey, Calif., presented at the SAE National Aeronautic Meeting, sponsored by the Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N. Y.

Shrinking the Control Panel

After trying all the accepted solutions to the problem of bringing machine control panels to reasonable dimensions, and after all such solutions proved unsatisfactory, a new approach was attempted: to use smaller relays to replace the 600-volt, 10-15 amp rated contact relays normally found in the control panels. This seemed especially feasible as the relays, though designed for 600 volts, were operating on only 115 volts.

Though success has not been unqualified, this is ascribed to the fact that the manufacture of smaller relays has begun only recently. Now available commercially are three types, with others soon to be announced.

Of those now available, the first is a plug-in relay. Its panel-mounted socket is front wired, and the panel mounting

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

can be done without relays. It requires panel space $2\frac{9}{16}$ by $2\frac{21}{32}$ inches. Contact configuration is two normally open and two either normally open or normally closed. Still on test, this type of relay looks promising.

Another relay is available in a four and an eight-pole construction with several contact combinations. Required panel space is $1\frac{11}{16}$ by $3\frac{1}{8}$ inches. Except for one which was damaged during installation, all relays tested survived 10 million operations, and most were still operating after 20 million.

The third available type is a throw-away model needing a panel area of $2\frac{3}{4}$ by 2 inches. It has eight contacts that can be arranged in any combination from eight normally open to eight normally closed. Currently under test, it also looks promising.

How do such small relays affect the size of panel enclosures? In one case, panel size was reduced from 32 to 20 feet, in another from 28 to 18 feet.

While none of the relays tested has undergone sufficient field experience on

which to base a reliability index, it seems reasonable to conclude that small dependable relays for industrial applications are distinctly possible, and that, now that their need has been proved, they will be forthcoming.

From a paper "The Electrical Control Panel Enclosure Space Problem" by John Zambrzycki, Ford Motor Co., Detroit, Mich., presented at the 25th Annual Machine Tool Electrification Forum, sponsored by Westinghouse Electric Corp., Pittsburgh, Pa.

Helical Rotary Compressor

The gap in the compression and flow ranges characteristic of the reciprocating compressor and of aerodynamic machines is filled by the helical, rotary, positive displacement type. Large overlap at each end of the range permits other factors to be considered in making a choice in these borderline regions.

Experience has shown that a number of formulas applicable in the study of thermo and gas dynamics also apply to this type of machine, permitting the prediction of its over-all performance and characteristics.

As there is no contact between the rotors themselves, or between the rotors and the housing, operating speeds can be substantially higher than in reciprocating machines of equivalent size. Mechanical efficiency is in the range 0.91 to 0.98.

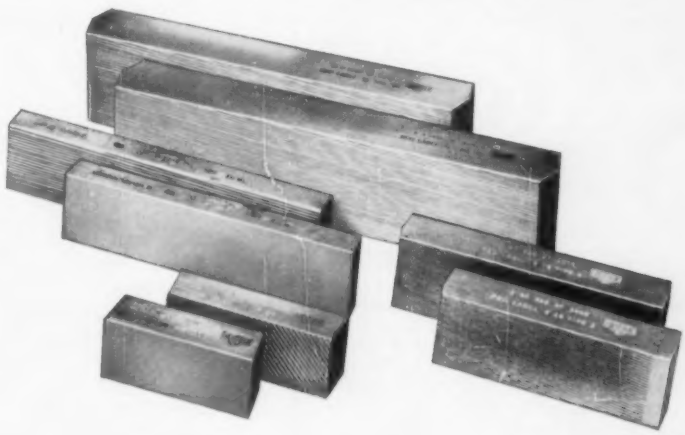
Data obtained from application of formulas is used to prepare a performance map and a performance selection chart, from which may be determined the size of machine needed and the horsepower input required to drive it.

From a paper "Characteristics of Helical, Rotary, Positive Displacement Compressors" by Karl E. Wichert, Fairchild Engine and Airplane Corp., Bayshore, L. I., N. Y., presented at the joint ASME-EIC Hydraulic Conference, sponsored by The American Society of Mechanical Engineers, 29 West 39th St., New York 18, N. Y.

New Steels and Mill Shapes

Strength of commercial, economical steels is increasing at an accelerated rate. Where ASTM A7 (33,000 psi yield strength) was followed by ASTM A36 (36,000), subsequently developed classes of steels, including some now in the commercial development stage, raised the strength levels by considerable margins. In the 50,000 psi range there is a whole group including ASTM A242, A440, A441 and USS Ex-Ten. These were followed by USS Tenelon (70,000), "T-1" (100,000) and more recently by USS Strux (240,000). The gap between the 100,000 and the 240,000 psi levels will soon be filled by a group of steels in the 140,000 psi range, while the high strength frontier will be pushed back by steels in the 300,000 psi

More Can Be Done



With Reed Flat Dies!

Reed, working closely with the fastener industry to broaden the application of thread and form rolling, precision-engineers its "Red Label" Flat Dies to produce products that are of superior quality, accuracy and uniformity. These include wood, machine, lag and tapping screws or knurling made on all types of reciprocating thread rolling machines.

Reed Flat Dies of selected steel are carefully heat treated to insure maximum life and are thoroughly inspected to meet rigid standards of quality control. As the pioneer-leader in the development of all types of thread and form rolling equipment, Reed can supply over 300 types and sizes of Flat Dies from stock for a wide variety of applications. Special dies on order.

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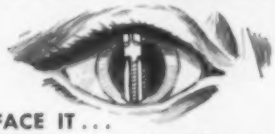
THERE'S MORE TO TAPS THAN MEETS THE EYE!



LET'S FACE IT . . .
You will not notice a major difference when you visually compare the same style standard High Speed Steel, ground-from-the-solid taps made by Jarvis with those made by another quality manufacturer.

They will look alike, measure alike . . . they are made of quality steel. With this apparent similarity . . .

. . . THEN WHAT ARE THE IMPORTANT POINTS TO CONSIDER IN SELECTING TAPS?
Selecting the *right tap for the job* is vitally important for top tap performance. Regardless of its quality, the wrong tap cannot do the job properly. And, as you know, poor tap performance can be costly.

3 KEY POINTS TO REMEMBER
The differences in ground thread taps become apparent in their performance. The key to proper tap selection lies in these three critical areas:

1. Selecting the correct tolerance with respect to tapped hole limits.
2. Selecting the correct type of chamfer, chamfer relief, flute contour and pitch diameter relief.
3. Selecting the style of tap as regards number of flutes, or whether it should be spiral pointed or spiral fluted.

HOW TO GET HELP FOR PROPER TAP SELECTION
Jarvis has gone to great lengths to make tap specifying information available. The new Jarvis Tap catalog has a complete section devoted exclusively to engineering information and guidance for tap selection. Also, Jarvis offers its now-famous, handy pocket-size Tap Selector Guide. Both are free for the asking.

In addition, Jarvis sales-engineers are always ready to help solve your tapping problems.

THERE IS A BIG DIFFERENCE IN TAPS AND IN THEIR PERFORMANCE. YOU CAN PROVE THIS TO YOURSELF BY DEPENDING ON JARVIS THE NEXT TIME YOU ORDER TAPS.

WANT ONE OR BOTH?
- **New Jarvis Tap Catalog** (includes 25-page engineering section)

Jarvis Pocket-Size Tap
- **Selector Guide**

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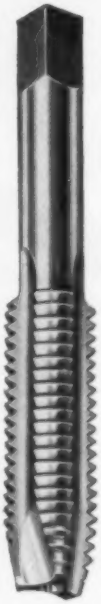

SPIRAL POINTED TAPS

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Of particular interest in Jarvis' Spiral Pointed Taps is the exceptionally wide range of Standard sizes (1/4" to 3/4") ready for immediate delivery at regular (standard) prices. You will surely save time and money.

Also available: machine screw sizes #0 — #14 in stock plus wide range of Specials.

5 JARVIS TAP FACTS

1. Years of experience in the manufacture of High Speed Steel ground-from-the-solid taps *exclusively*.
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range, whose development is also underway.

An advantage in fabrication is that the higher strength steels achieve their strength as the result of a metallurgical transformation obtained through quenching, normalizing and other heat treatments, and—in the highest strength ranges—by precipitation hardening. This permits fabrication while the steel is at the lower-strength level, generally about 70,000 psi, to be followed by the proper treatment to obtain the required high strength.

During the past year, eleven new structural shapes have been made available in the lightweight sections, permitting weight savings of up to 18.5 percent over previously available lightweight sections. As is always the case, greatest economies in the use of these new sections can be achieved by using them as starting points for design rather than as substitute materials.

From a paper "New Steels and Products for Advanced Engineering Design" by R. W. Simon, vice president of metallurgy, United States Steel Corp., presented at the United States Steel Corp.'s Steel Design and Engineering Seminar.

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Repairing Patented Machines

It is generally understood that patent grants confer the right to exclude others from making, using or selling the invention to which the patent is directed. In addition, a purchaser of a patented machine is permitted to make reasonable repairs when necessary to keep the machine in working order. However, the right to use and to repair—in the absence of an express agreement—does not include the right to reconstruct. Thus, if the purchaser reconstructs the machine, he becomes liable in damages to the patentee and subject to being enjoined from further use of the machine. The motivation of the complaining patentee in such a case is, of course, the loss of a sale or other material gain as compensation for services under a rebuilding contract.

Fortunately, court decisions do provide certain guides useful to one charged with making a decision regarding rebuilding. It is established that if the replacement part is not a component of the combination to which the patent claims are addressed, the purchaser cannot be held to have stepped beyond his implied license. However, in all such cases, one should be careful that the replacement part is not, per

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se, the subject of a patent. It is further established that where the part replaced by the purchaser, although a component of the patented combination, is one which, by the nature of the machine and the work it does, becomes worn out after limited use, the purchaser cannot be held guilty of infringement.

In one case involving the knives of a patented planing machine, the court held that the knives were the ultimate tool of the invention and were "liable to be often worn out or to become inoperative with respect to their intended effect." The court also attached importance to the fact that the patentee contemplated that it would be necessary to replace the knives frequently.

In another significant case, in which the patent concerned an axle construction, the decision of the court turned on the fact that the parts not replaced by the purchaser so dominated the overall construction that the substitution could not be considered a rebuilding. In other words, in the opinion of the particular court the rule or test to be applied is the test of dominance. If the substituted parts dominate the structure after their installation, the purchaser is liable for infringement.

From a paper "A Patent Problem Deriving From Machine Maintenance," by Bryce Beecher, General Motors Corp., Detroit, Mich., presented at the Winter Annual Meeting of the American Society of Mechanical Engineers, 1960.

Strength of Diamond Grits

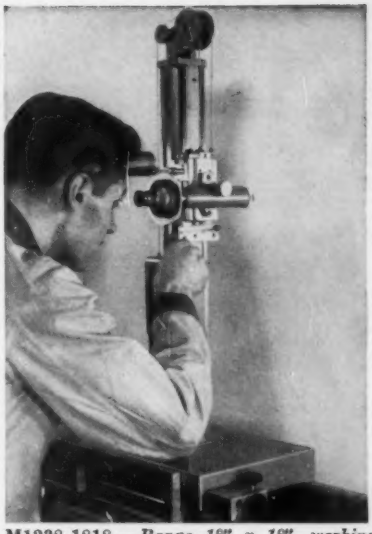
Investigations at the Diamond Research Laboratory show that best diamond grit for saws and grinding wheels is a function of the type of bonding agent: metal bonds require grit particles that are as strong as possible, while resinoid bonds work best with fragile grits.

Translating these requirements into physical shapes, grit particles to be used in metal bonds should be blocky, while those for use in resinoid bonds should be needle or plate shaped.

In the case of blocky grits, freedom from cracks or other defects is also important, as such faults provide nuclei that facilitate the fracture of the block.

A new method for testing diamond grits submits accurately measured small quantities of the grit to statistically controlled impacts over a standardized time interval, then measures the resulting fines as a percentage. Results obtained have good qualitative correspondence with efficiency of metal bonded grinding wheels made from these grits and used in carbide grinding.

From the brochure "A Comparative Method of Evaluating the Strength of Diamond Grits" by R. Weavind, A. A. Linholm, and A. R. Roy. Diamond Research Laboratory, Johannesburg, South Africa.



M1238-1818 — *Range 18" x 18", working distance 9" to infinity. Reads to 0.001" up to 24" working distance. Protractor ocular reads to 3 minutes of arc. Image is erect.*

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These convenient, reliable optical instruments permit making precise coordinate measurements in a vertical plane. The two dimensions are measured with one setting, object does not have to be rotated. Inspection time is cut in half and resetting errors eliminated.

Versatile Gaertner Coordinate Cathetometers are ideally suited for precision measurements on large objects; also objects or points in recessed, remote, or inaccessible locations. Applications include measuring jet engine sections, complicated castings, printed circuits, bolt holes and bosses on large piece parts, traces on cathode ray tubes, etc.

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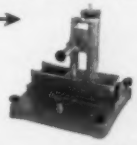
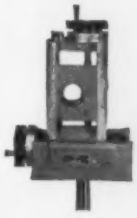
M1236-46— Horizontal range 6", vertical range 4", Reads to 0.0001", working distance 5" to infinity.





M1236-22— Range 2" x 2", reads to 0.0001". Working distance 5" to infinity. Shown with 19 mm mounting rod, and without telemicroscope. Instrument permits precise coordinate movement of other objects such as photo cells, probes, etc., in place of telemicroscope.

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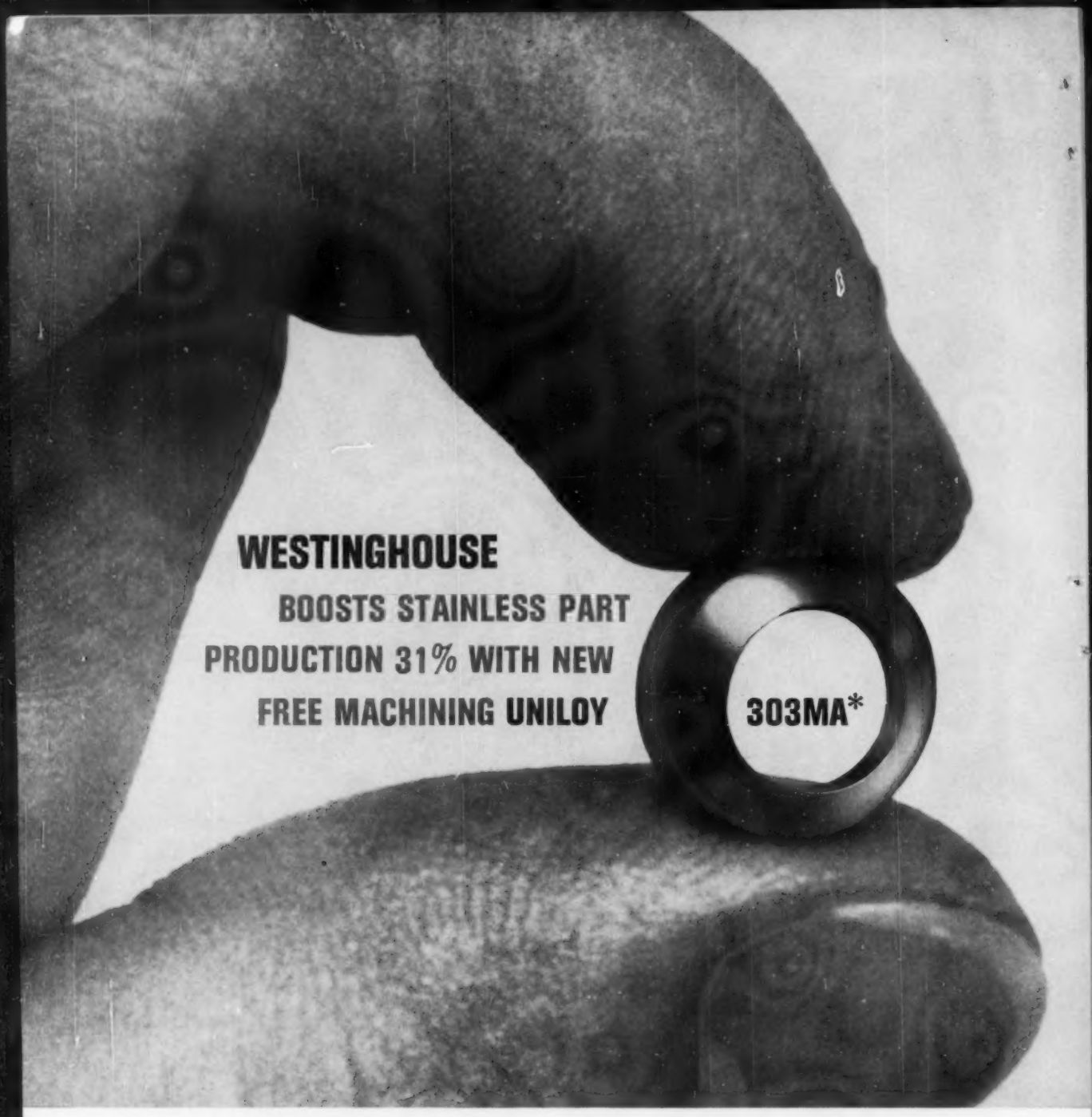

The Westinghouse Standard Control Division at Beaver, Pa., compared New free machining Uniloy 303MA* stainless steel with regular Type 303. The part—a close tolerance spring end support for circuit breakers and control equipment—was machined from ½-inch stock. Here are the production line results:

	AISI Type 303	New Uniloy 303MA
Spindle Speed	890	1180
Surface Ft. per Min.	115	155
No. Pieces per Hour	110	144
Tool Life	Form tool sharpened 3 times every 8 hours	Form tool sharpened once every 6 hours

New Uniloy 303MA also machined cleaner and smoother to produce higher quality parts. It is now specified in all applications formerly calling for Type 303 stainless steel at this plant.

Cut *your* production costs! Order New Uniloy 303MA at your nearest Universal-Cyclops steel service center or sales office. Ask for your copy of the "Uniloy 303MA" brochure.

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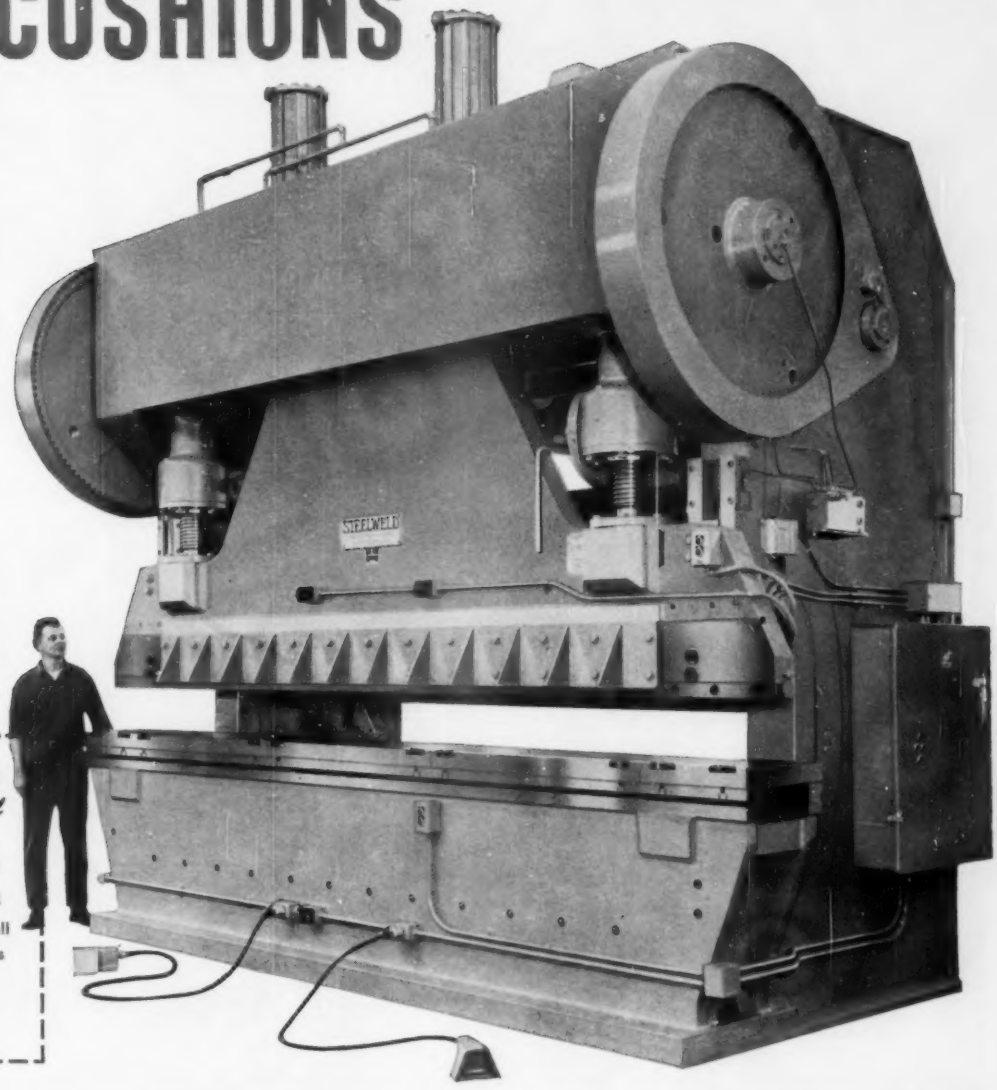
This die-cushion-equipped mechanical Steelweld press brake has two speeds, 7 and 20 strokes per minute. Stroke length is 6 inches. Shut height is 20 inches.



Steelweld *Mechanical and Hydraulic* **Press Brakes** are available in all sizes to 2000 tons capacity for plate lengths to 30 feet.

Steelweld Press Brakes — mechanical or hydraulic — can be furnished with die cushions built in.

The brake illustrated was provided with twelve pneumatic die cushions assembled in a single line between the two bed plates. Each has a rating of four tons, or 48 tons total, when operated at 100 lbs. air pressure. Maximum capacity is 60 tons at 125 lbs. air pressure. Stroke of the cushions is adjustable from 0 to 3 inches.

The machine is rated 400 tons and will bend 12' x ½" mild steel between housings. Total length of bed and ram is 16'-0" including 10-inch extensions at both ends. The double plate bed is 20" wide. The ram has detachable brackets on either side. Throat depth is 18". Air-operated ram counterbalances are provided.

Control is air-electric with two foot stations for operation by one or two men. It includes "inch" and "run" with automatic stop at top of stroke. Ram adjustment is motorized. Back gauge has a range of 48 inches and rides on ball bearings. It is motor driven and front operated.

The design of Steelweld brakes simplifies the incorporation of die cushions and various features found helpful for metal forming operations. Therefore, it is possible to include at reasonable cost special features that will speed or aid unusual forming work.

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Here's why Lufkin's indicator is the most sensitive!

Lufkin's V32 Dial Test Indicator is made with the precision of a fine watch, with jeweled bearings for longer life.

It has a 180° contact point swivel. The dial has clear, easy-to-read graduations to .0001"... and a switch lever for full reverse action.

Exclusive ball-bearing mounting reduces friction, assures greater accuracy—an excellent example of how Lufkin leads in precision-tool design.

Mount the V32 on a Lufkin Miti-Mite Holder with its rigid (5/16") center post and you have a vertical testing setup that will stay firmly in place. (There's a permanent magnet in the base with a 50-lb. pull.)

See your industrial distributor. He knows precision tools and can show you how Lufkin leads in design and craftsmanship. His stock is maintained to fit your needs. See him for prompt and reliable service. LUFKIN, Saginaw, Michigan.

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new leader in precision tools!

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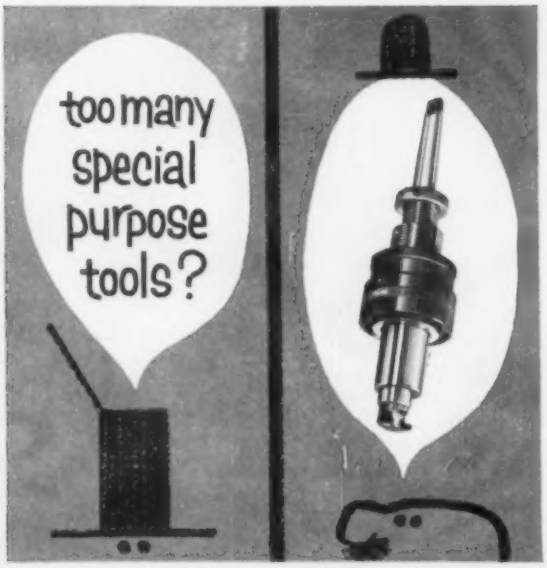

Scully-Jones automatic-feed recessing tools adapt standard drill presses and radial drills to a variety of intricate recessing jobs. "Building-block" design increases work range, reduces tooling cost. Feed is automatic and continuous. Choice of interchangeable stop collars and pilot nose assemblies to pilot either in fixture bushings or in work. For work hole diameters from 3/8" to 4½"; depths of cut to .300". Ask for Bulletin No. 10-50.

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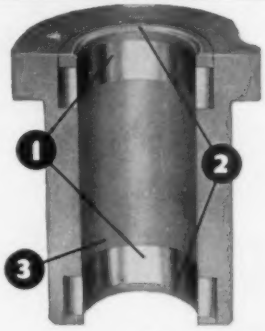
BUSHING STORY IN A NUT SHELL



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1. Tungsten carbide rings at the points of wear; 2. Steel rings protect drills and carbide; 3. Special hardened alloy steel body; 4. Performance: same as solid carbide, but need not be handled with kid gloves; 5. Greatest economy, because of maximum life at minimum cost; 6. Enjoy the advantages of greater accuracy for a longer time, less spoilage, less machine down-time, added drill and jig life with MEYCO carbide inserted drill jig bushings.

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MEYCO **W. F. MEYERS CO., Inc.**
BEDFORD, INDIANA
A famous name in precision tools since 1888

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EDLUND MODEL NPB

PRINTED CIRCUIT BOARD DRILLING MACHINE

DRILL PRINTED CIRCUIT BOARDS FASTER, CHEAPER, AND MORE ACCURATELY

Now High Speed, Versatile, Tape Controlled Machine drills Printed Circuit Boards with amazing accuracy in a wide variety of material at low cost.

This High Production drilling machine is actually 16 drills in 1, it drills four boards or stacks of boards simultaneously, operating at 50 cycles per minute under average conditions. **Time Saving Versatility** is featured with 4 independent air feed units in each drilling cluster, each unit capable of carrying a different drill size and operating at spindle speeds up to 22,000 RPM. **The Tape Controlled point positioning** table and drill units assure maximum accuracy and reliability. Now drilling speed and size changes are done automatically, eliminating time consuming manual tooling and set-up.

Printed Circuit Boards Drilled on Edlund Machine

Edlund Model TPR Programmer for Tape

EDLUND PROGRAMMER PREPARES TAPE DIRECTLY FROM ART WORK

This unique Programmer prepares 1" 8-channel tape **DIRECTLY** from the draftsmen's art work at a **LOW INITIAL** and **LOW UPKEEP** cost.

ELIMINATE MASTER BOARDS and **SAVE** by preparing tape directly from art work. **HIGH SPEED PERFORMANCE** locates up to 30 positions per minute. **MAXIMUM ACCURACY AND RELIABILITY** are the result of the unique design which corrects errors in the art work and keeps the programming process on the desired grid automatically. **INDEPENDENT OPERATION** permits tapes to be prepared when drilling machine is in use. **COMPLETE VERSATILITY** is provided by precision interchangeable slides allowing the Programmer to handle grid sizes down to .025" including unusual grids.

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EDLUND MACHINERY COMPANY

Division of Harsco Corporation Cortland, New York

Edlund Representatives in Major Cities

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In SPINDLES for electrolytic metal removal

..."We build a better mouse trap" EVERY DAY!

The "mice" we're after of course, are the thousand-and-one special problems that plant engineers from all over the nation bring to us for solution. In missile, aircraft and general manufacturing, we're batting 1.000!

We think it's because we're "old timers" in this new field. We can solve your problem today because we solved one like it yesterday.

SKETCH IT OUT • SEND IT IN • WE'LL PROVE IT!

STANDARD
Super-Precision Spindles have
CONVERTED:
Planers • Lathes • Milling Machines
Gantry Mills • Tool and Cutter Grinders
Surface Grinders
Special Machinery

STANDARD Super Precision Electrolytic Spindles are available in 50 to 3000 AMP Capacities.

For Mist Control use ***Mist Air-rester***

the STANDARD electrical tool co.
PRECISION SPINDLE DIVISION
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HALLMARK OF METALWORKING THROUGHOUT THE WORLD

HARTFORD Special

DRILL UNITS for VERSATILITY

Easy adjustment of feed rate and stroke length makes Hartford air-hydraulic units quickly adaptable to a wide range of drilling and tapping jobs.

Model 17-400
4" Stroke

Write for new bulletins on these drill units and other Hartford building block components for production machines.

THE HARTFORD SPECIAL MACHINERY COMPANY
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TUMBLING MEDIA for Deburring and Finishing

Preforms in over 300 shapes, sizes and bonds for all barrel and vibratory operations.

- Finest bonding materials
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- Minimum media fracture
- Maximum production

Free lab service reports proper media for your parts.

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DYKEM STEEL BLUE

Stops Losses making Dies and Templates

Popular package is 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

Write for sample on company letterhead

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2303D North 11th St. • St. Louis 6, Mo.

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NEW!

1961 CATALOG-PRICE LIST

Catalog No. 6, illustrating standard fixture clamps, jig and fixture details, from the industry's best known and largest manufacturer.

Complete and generous stocks of standard items are available from the Morton factory and strategically located warehouses, and distributors.

Call your local distributor, or write to the factory today, for your copy of this informative catalog.

MORTON MACHINE WORKS • Division Brubaker Tool Corp.
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You Name the Job...

A MANHATTAN ABRASIVE WHEEL
WILL REMOVE MORE METAL, FASTER—AT LOWER COST!

- ROUGHING WHEELS
- FINISHING WHEELS
- CUT-OFF WHEELS
- DIAMOND WHEELS
- SAFETY BACK FLARED CUPS
- *NEW* FAST CUT MOLDISCS
- *NEW* LONG-LIFE MOLDISCS
- *NEW* SNAGGING WHEELS FOR AUTOMATIC BILLET GRINDING

ARE YOUR NEEDS LISTED HERE?

You Can Get a Manhattan Abrasive Wheel Custom-Designed for Any of These Jobs.

Foundry Snagging—Billet Surfacing
Centerless Grinding
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Grinding and Finishing Stainless Steel Welds
Bearing Race Grinding and Finishing
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Foundry Cutting—Standard and Reinforced Wheels
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ABRASIVE, GRAIN SIZE, HARDNESS, STRUCTURE, BOND—EVERY WHEEL COMPONENT IS SELECTED FOR YOUR CUTTING AND GRINDING REQUIREMENTS. SEE YOUR MANHATTAN ABRASIVE WHEEL SPECIALIST.

SPECIFY* MANHATTAN *FOR MORE OUTPUT PER MAN HOUR—

"MORE USE PER DOLLAR"

RM1065

ENGINEERED RUBBER PRODUCTS ..."MORE USE PER DOLLAR"

RM

WRITE TO ABRASIVE WHEEL DEPARTMENT

MANHATTAN RUBBER DIVISION—PASSAIC, N.J.

RAYBESTOS-MANHATTAN, INC.

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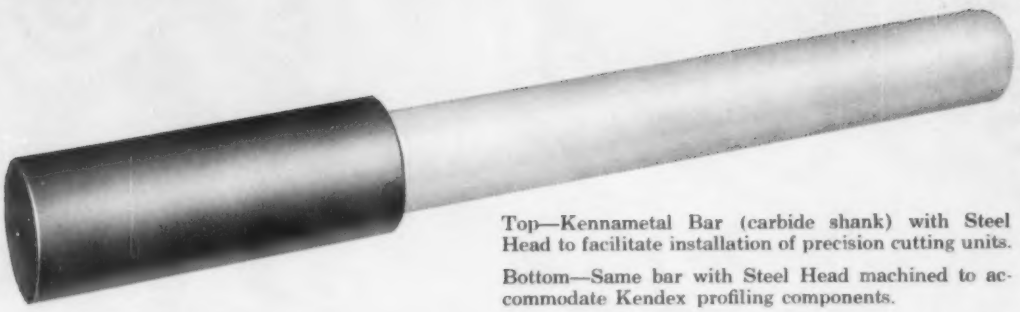
Sub Surface to Outer Space

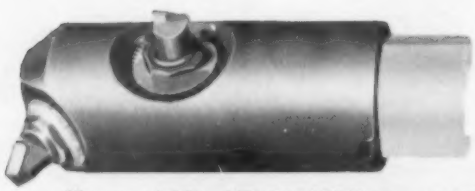
Under or on the surface of the earth, in the air or in outer space, screw threads are vital to man's ability to live, move or work. Strip his inventions of screw threads and he would return to a village handicraft existence. Yes, it would be hard to overstate the importance of screw threads in our modern world, and equally hard to imagine generating internal screw threads efficiently without taps. If you use either standard or specially designed taps for products on which men's very lives depend, can you afford to use any but the best?

BUY TAPS WITH CONFIDENCE, BUY GREENFIELD TAPS **GREENFIELD TAP & DIE** GREENFIELD, MASS.

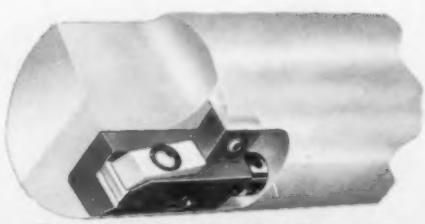


Top—Kennametal Bar (carbide shank) with Steel Head to facilitate installation of precision cutting units.

Bottom—Same bar with Steel Head machined to accommodate Kendex profiling components.



Kennametal Semi-Finished K-Bar converted to accommodate adjustable boring head.



Kennametal Semi-Finished Bar with Kendex Adjustable Unit installed.

NOW KENDEX* K-BARS WITH STEEL HEADS FOR MAKING "SPECIALS" FAST

10 STOCKED SIZES FOR MANY APPLICATIONS

This new line of Kennametal* bars, attached to machinable steel heads, speeds the making of special tooling to produce straighter holes and better surface finishes on precision boring jobs.

With these bars you get all of the advantages of Kendex K-Bars with shanks of rigid Kennametal, plus speedy adaptability to meet requirements of a wide range of boring operations. The rigid Kennametal shank (94,000,000 psi vs. 30,000,000 for hardened steel) minimizes deflection and reduces chatter by damping vibration. K-Bars permit greater length-to-diameter ratios to be used, and feeds and speeds to be increased. Closer tolerances can be maintained. Extra boring and grinding operations are often eliminated to further reduce unit costs.

The steel heads (28-32 Rockwell C) can be machined for various types of cutting inserts—such as Kendex adjustable units or other types of precision cutting mechanisms. The steel heads provide a generous amount of stock to provide for any tooling normally required on a particular bar diameter.

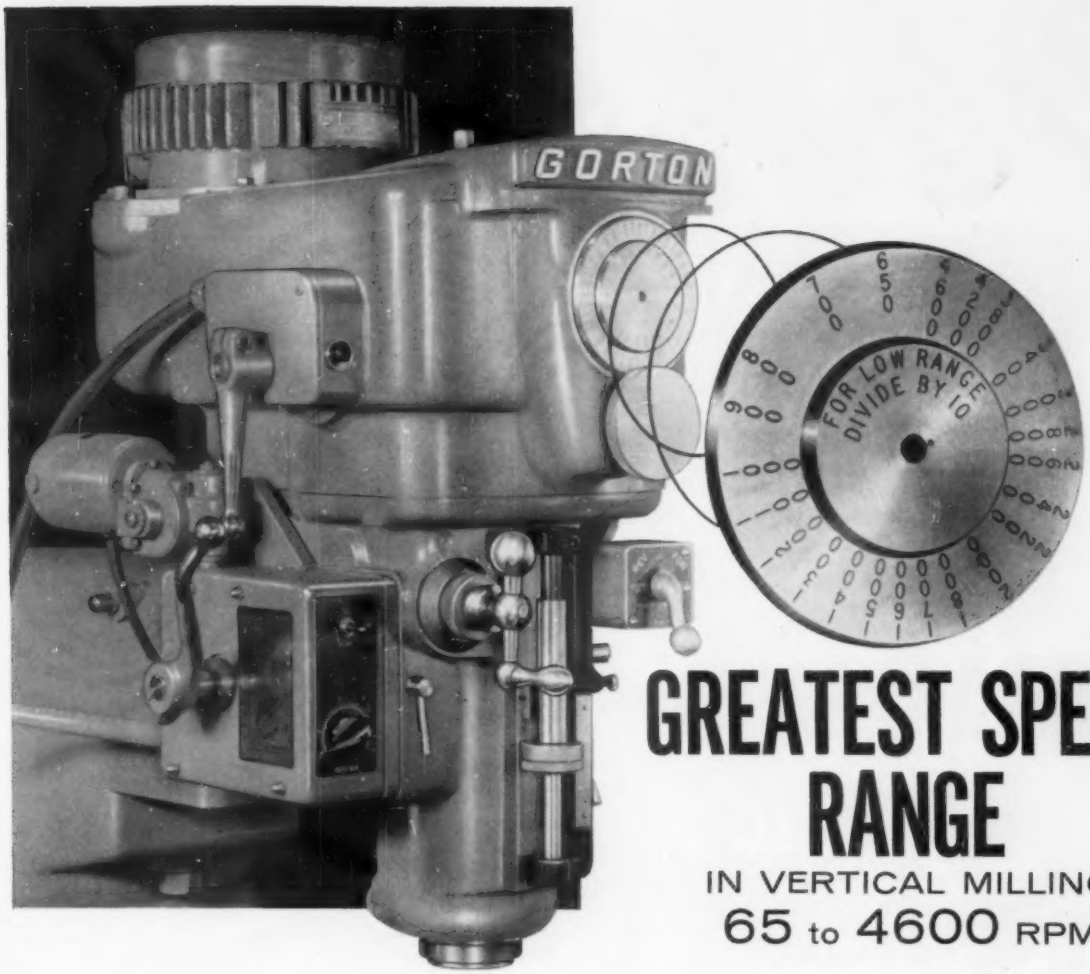
Ten sizes of semi-finished K-Bars are available from stock. Bar diameters range from 7/16" to 2½" . . . steel head diameters from ¾" to 4⅝". Bars range in length from 7⅝" to 28¼". Bars with shank diameters of ¾" and larger have a coolant hole through the center.

For complete information, call your Kennametal Carbide Engineer. He has a desk demonstrator that lets you *feel the difference* in the rigidity of Kennametal and steel. And he can show you samples of surface finishes produced by K-Bars and steel bars, under identical conditions, that demonstrate the value of Kennametal's high rigidity. KENNAMETAL INC., Latrobe, Pa.

*Trademark

35808

INDUSTRY AND KENNAMETAL ...Partners in Progress

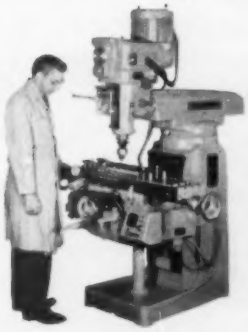


GREATEST SPEED RANGE

IN VERTICAL MILLING
65 to 4600 RPM

New GORTON VARIABLE SPEED HEAD Model 1-22 Mastermil

- The ideal head for milling high tensile strength alloys with maximum cutter efficiency.
- Remarkably smooth spindle operation throughout entire speed range from 65 to 4,600 RPM . . . insured by *unison-mechanical* change of pulley diameters, with positive control.
- Guaranteed high precision spindle of interchangeable self-contained design.
- Direct reading spindle speed dial provides fast speed selections.
- Maximum torque in low speeds through back gear design.
- Dial-type down feed—infinitely variable .250 to 4.000 inches per minute with built-in over-running clutch for feeding against positive stop.
- Traditional GORTON quality in every detail.



Write for Bulletin No. 2699 for complete description of new variable speed head and Gorton Mastermil.

GORTON
SINCE 1893

GEORGE GORTON MACHINE CO.
2610 RACINE STREET, RACINE, WISCONSIN

Milling, Die Sinking, Profiling and Engraving Machines with Manual Hydraulic, Electro-Hydraulic or Numerical Guidance Systems. Special Machines and Automated Transfer or Indexing Machines. Cutting Tools and accessories...Defense and special products.

MARSHALL
DRILL ROD

In standard 36" lengths and also available in 12' lengths.

OILcrat—OIL HARDENING (SAE-01)

WATERcrat (commercial). Water hardening.

Ask your **MARSHALL** distributor about **OILcrat, AIRcrat, MARSHALLcrat** and **SCRIBE-IT** ground flat stock.

The MARSHALL STEEL CO.
The Aristocrats of Ground Flat Stock
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P. O. BOX 108 LA GRANGE, ILLINOIS

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FORD
UNIQUE UNICAM RESHARPENING FIXTURE

Resharpen the famous **FORD UNIFLUTE COUNTERSINK** in your own shop to original factory specifications

- Restores original factory cam-relief
- Reduces sharpening time and costs
- Easily adapted to your tool room equipment

Packaged assembly, including cam body, locating ring, adapter sleeves and key. Set No. SUC-1, List Price, $30.00 Dept. TE 1061

Rotary FORD Tools

M. A. FORD MFG. CO., INC.
1545 Rockingham Rd., Davenport, Iowa
Phone 324-3251 TWX DV-66

Manufacturers of Precision Cutting Tools
Dealerships Available

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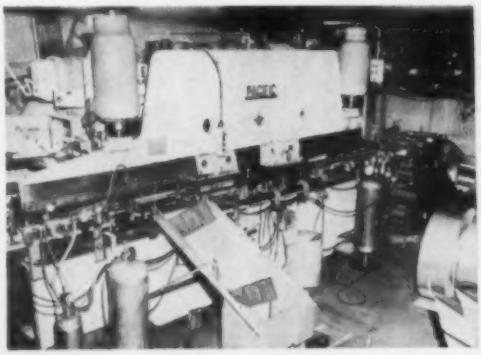
PACIFIC HYDRAULIC...THE FAST PRESS BRAKE produces 40 shingles per minute automatically



To match most production requirements, Pacific Hydraulic press brake can be set to a short stroke to eliminate all wasted motion and to cycle at high speeds. At Precision Industries, Honolulu, a single 150 ton Pacific produces, completely automatically, 40 shingles of 20 gauge aluminum every minute combining 7 separate operations with each stroke of ram. The press has an automatic feed including coil cradle, straightening roll, air slide feed, progressive dies and air ejector. Any plant, large or small, can handle a variety of jobs more economically on a Pacific.
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PACIFIC PRESSES & SHEARS
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M-B PNEUMATIC GRINDERS

Model M-CR-B

Model U-TR

Model HD-CR

Outstanding, powerful, fast-cutting tools of proven high efficiency. Designed for tough jobs and real production. Perform indefinitely and dependably. Precision made. Steel housing for safety. Also other models.

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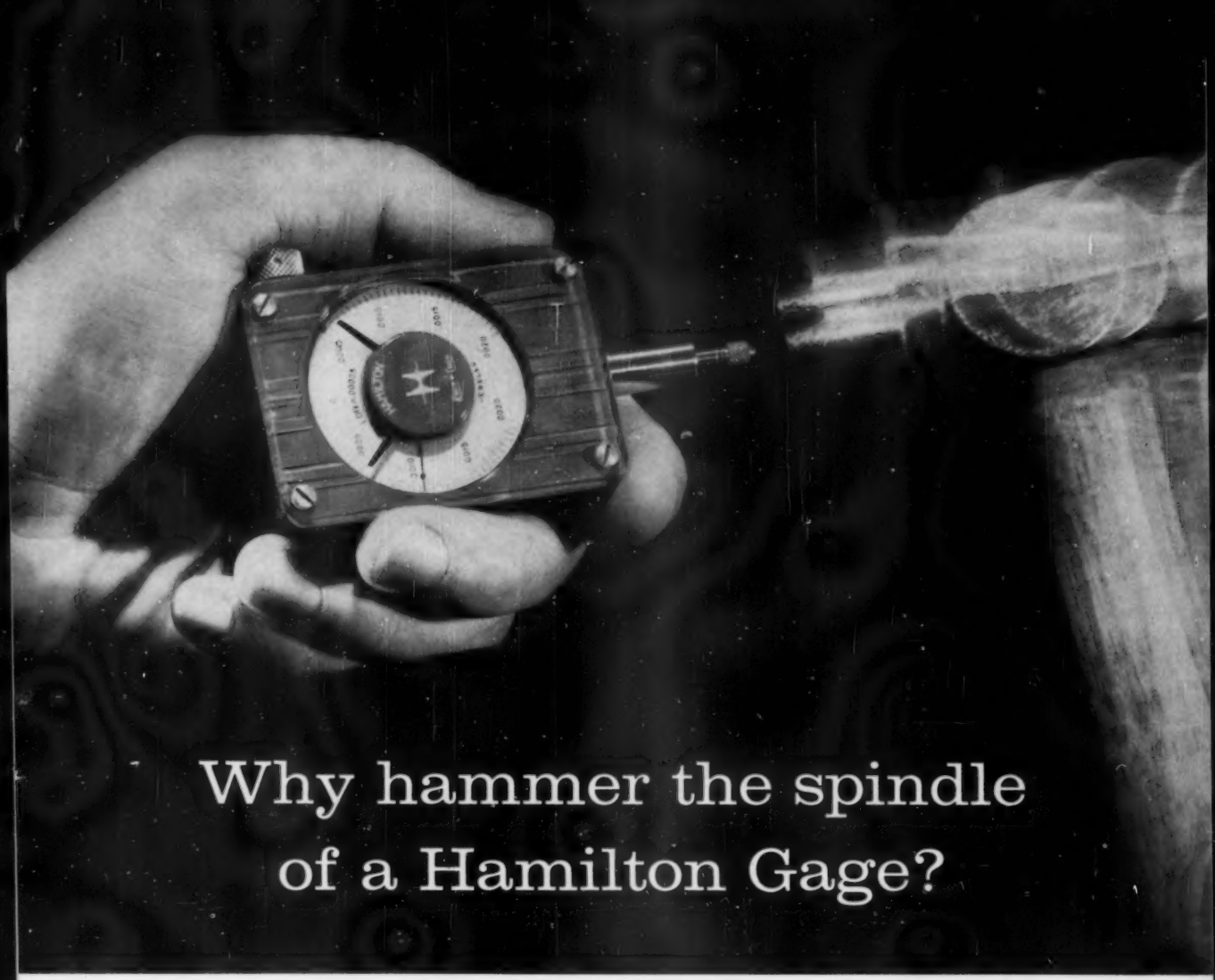


Why hammer the spindle of a Hamilton Gage?

To prove that Hamilton Gages are built to take it. (You can drop a Hamilton Gage on its spindle and it still maintains its accuracy.) The reason: a unique, indirect transmission action from spindle to gear mechanism. Pressure at the spindle end *releases* the movement for operation rather than driving it. As a result, any shock at this point cannot force the gear mechanism . . . and *you* cut replacement costs.

More reasons why you can depend on Hamilton Gages? Hamilton's offer of a complete movement replacement for a nominal charge. Hamilton's gage repeatability to .00001". Hamilton's light gaging force (2 or 4 ounce) that's adjustable. Hamilton's years of watchmaking experience, so valuable in maintaining the fine accuracy of precision gages. Hamilton's complete line of mechanical and electric gages for post-process inspection or in-process production control.

For free data sheets on Hamilton Gages, write to Dept. 2110, Hamilton Watch Co., Lancaster, Pa. They give full specifications on most items in our line. Or, if you have a special gaging problem, write directly to E. P. Barber, Director of Industrial Products Division.

Kwik-Chek Gages—another precision product of the

HAMILTON WATCH COMPANY

Industrial Products Division, Lancaster, Penna.

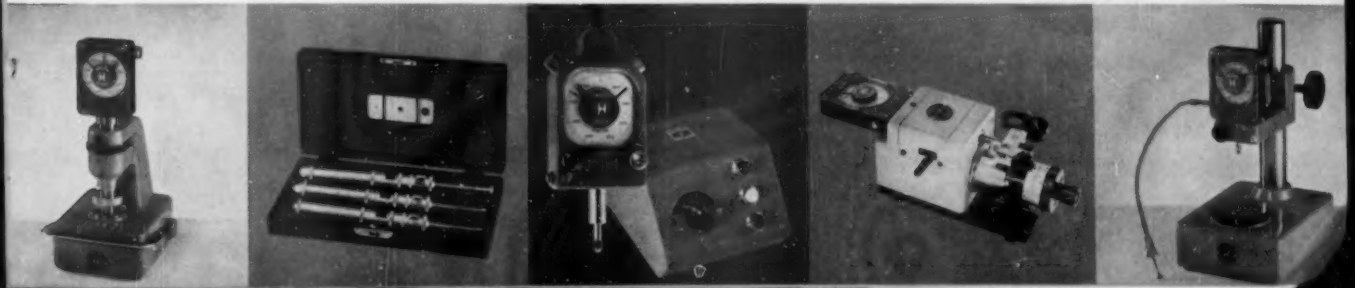
HAMILTON RECESS DEPTH GAGE for production gaging of recesses. Comes with both tiltable and rigid table for easiest location of parts.

HAMILTON HOLE GAGES replace as many as 700 plug gages. Precision accuracy in range from .025" to .380" . . . increments of .001".

HAMILTON ELECTRIC GAGING SYSTEMS for in-process control. Lights indicate several out-of-tolerance dimensions simultaneously.

HAMILTON HORIZONTAL INDICATING MICROMETER GAGE for absolute measurements. Accurate to .00005" over entire range.

HAMILTON PRECISION DIAL COMPARATOR for applications requiring ultimate in precision. Fine adjustment assures perpendicularity.



CUT Tooling COSTS

with

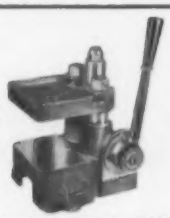
SWARTZ STANDARD FIXTURES AND FIXTURE LOCKS

TYPE LO—OPEN GUIDE POST

Double post rack and pinion separated to allow parts to project between posts • Light weight for easy shifts from operation to operation • Shown with Full Tray Head and Ball Weight Handle —numerous other styles available.

OVER 70 SIZES AND STYLES

TYPE L—FOR RIGID OFF SIDE CLAMPING—Three post design and totally enclosed base insures ample rigidity for all manufacturing needs • Full Tray Head and Plain Wrench Handle illustrated is only one of many combinations available.



TYPE LS—FOR SPRING CLAMPING

Provides automatic chucking and is constructed with a follow-up head • Piece cannot loosen during machine operation • Head styles to meet your needs—Full Tray Head and Removable Type Stub Wrench pictured.

TYPES LL AND LH—FOR LIGHT AND HEAVY DUTY CENTER LINE CLAMPING—Handle 2, 3 or 4 small parts per pass or single long awkward shape • Plain or Tray Heads • Double action Lock standard on LH Heavy Duty Fixtures—Locks closed *and* open.

SWARTZ STANDARD FIXTURE DIVISION

FARMA, MICHIGAN

FOR QUICK SERVICE, CONTACT THE DISTRIBUTOR NEAR YOU OR WRITE FACTORY DIRECT.

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FAMOUS SWARTZ LOCKS ARE USED IN ALL SWARTZ STANDARD FIXTURES

More than 40 sizes and styles • Single or double acting • Right or left hand • Wide assortment of wrench and handle types • Often used on special tooling.

GENERAL

Reuse Bases and Locks with new Head or retool old Head • Base Surfaces from 2" x 5" to 12" x 36" • Closed heights from 3" to 10"—specials to order • All fixtures manufactured from quality materials with precision Racks and Pinions • 100% final inspection • All Swartz Standard Fixtures available equipped for Automatic Air operation.

ASK DISTRIBUTOR NEAREST YOU (above) OR WRITE FACTORY DIRECT FOR YOUR ENGINEERING CATALOG OF SWARTZ STANDARD FIXTURES AND COMPONENTS

A DIVISION OF

UNIVERSAL VISE & TOOL CO.

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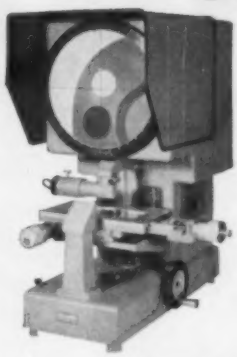
Stocker & Yale's UNIVERSAL OPTICAL COMPARATOR



. . . an extremely versatile instrument for precision gaging, inspection and production

The Model 10M Optical Comparator may be considered the most versatile *O*ptical *P*rojection *M*ethods (OPM) tool available today. Designed to utilize a complete line of standard accessories, this instrument provides either horizontal or vertical beam projections and both contour and/or front surface images.

NOTE THESE OUTSTANDING FEATURES

- Both contour and front surface projection — singly or together
- Clean, sharp, high-contrast screen images — easy to see without curtains or enclosures
- Large capacity staging area with 7¼" vertical elevation — more than adequate for the majority of work
- Accessories include protractor, stages and fixtures, interchangeable screens, and overlay charts, etc.

CUSTOM OPTICAL PROJECTION METHODS ENGINEERING

In addition to our broad line of standard comparators for precision applications, we probably have custom engineered and manufactured more special-purpose equipment than any other company in the field. What is your problem?

Write for Catalog No. 318A

STOCKER & YALE, INC.

52 Green Street, Marblehead, Mass., Tel. NE 1-0038

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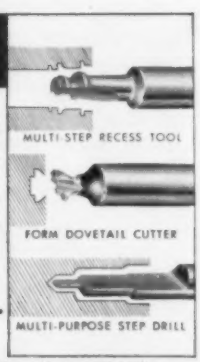
Your Tool Design Problem may already be solved



Woodruff & Stokes specializes in solving small cutting tool design problems. Years of tool engineering and a comprehensive knowledge of multi-operational tools enable us to solve your special tool problems faster and at less cost. W & S has designed small tools that combine five machining operations in one. Many of your machining operations might well be simplified or combined by use of special tools already developed by W & S. Our stockpile of solutions represents a short cut in time and lower tool cost for you.

Write today for information on W & S tools, or for recommendations on special tool design problems.

WOODRUFF & STOKES CO.
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Bldg. 32, 349 Lincoln St., Hingham, Massachusetts

Center Drills • Hollow Mills • Trepans • End Mills • Hexagon Broaches Recessing and Back Chamfering Tools for Screw Machines • Spline Broaches

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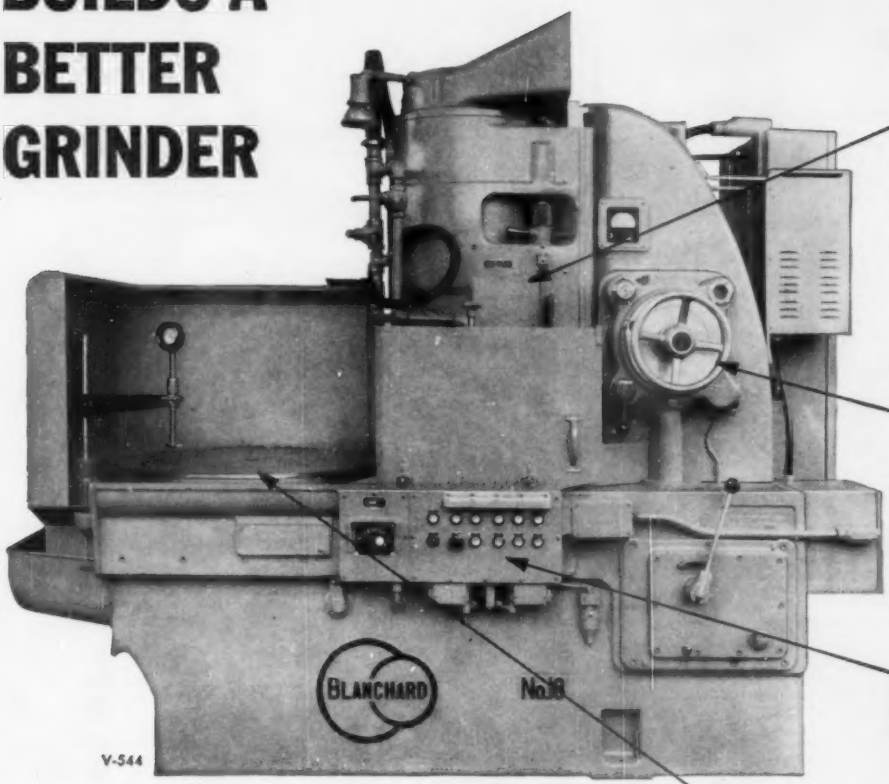
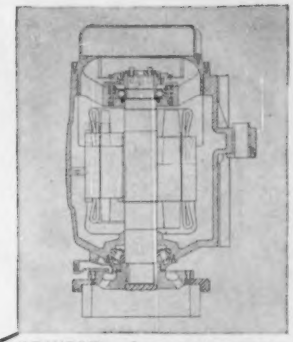
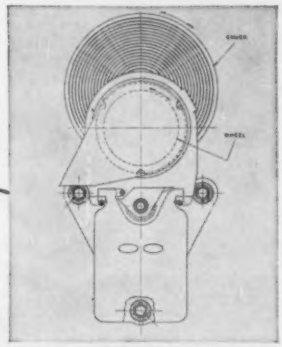
HOW BLANCHARD BUILDS A BETTER GRINDER



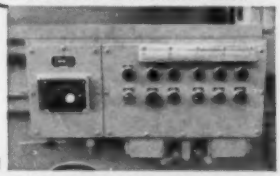
V-544



SPINDLE . . . incorporates a superior, pre-loaded anti-friction bearing system that removes all backlash and radial play. Integral "balanced" mounting of rotor on spindle eliminates vibration.



WHEEL HEAD COLUMN . . . is of heavy box-section design for extra rigidity . . . supported at 3 widely-spaced points. Column may be easily adjusted for alignment. Special column tilting devices available to produce concave or convex surfaces.



V-541

GRINDER CONTROL . . . is compact and conveniently located for fatigue-free handling. All control panels are BLANCHARD manufactured for troublefree operation.

W-949

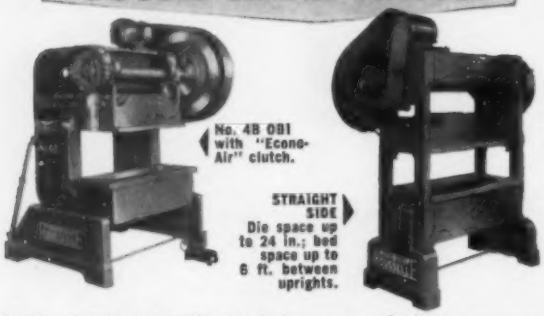
MAGNETIC CHUCK . . . provides maximum useful magnetic surface . . . has such closely spaced poles, that work as small as a quarter will always touch two or more.

There's no mystery about the *better* performance you get with a BLANCHARD Surface Grinder. It's simply a matter of *better* design of each individual machine part. For example, look at just 4 features of the No. 18, shown at the right.

Get complete details on all 24 models of BLANCHARD grinders. They're today's leading high precision, high production grinders on materials ranging from carbon to quartz . . . from bronze to steel. You can handle parts ranging from tiny jewels to giant plates up to 108″ across corners.

PUT IT ON THE BLANCHARD **THE BLANCHARD MACHINE COMPANY**
64 State Street, Cambridge 39, Massachusetts

High Output with ROUSSELLE
DOUBLE-CRANK PRESSES



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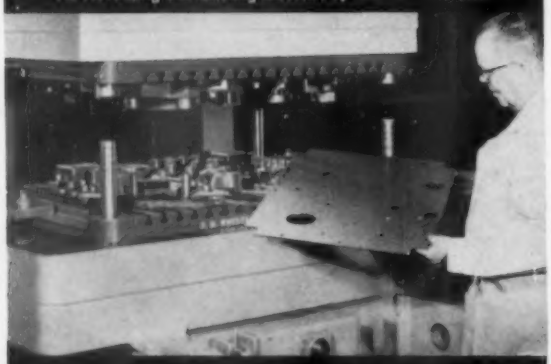

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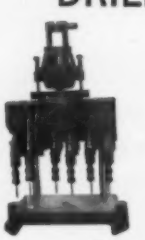

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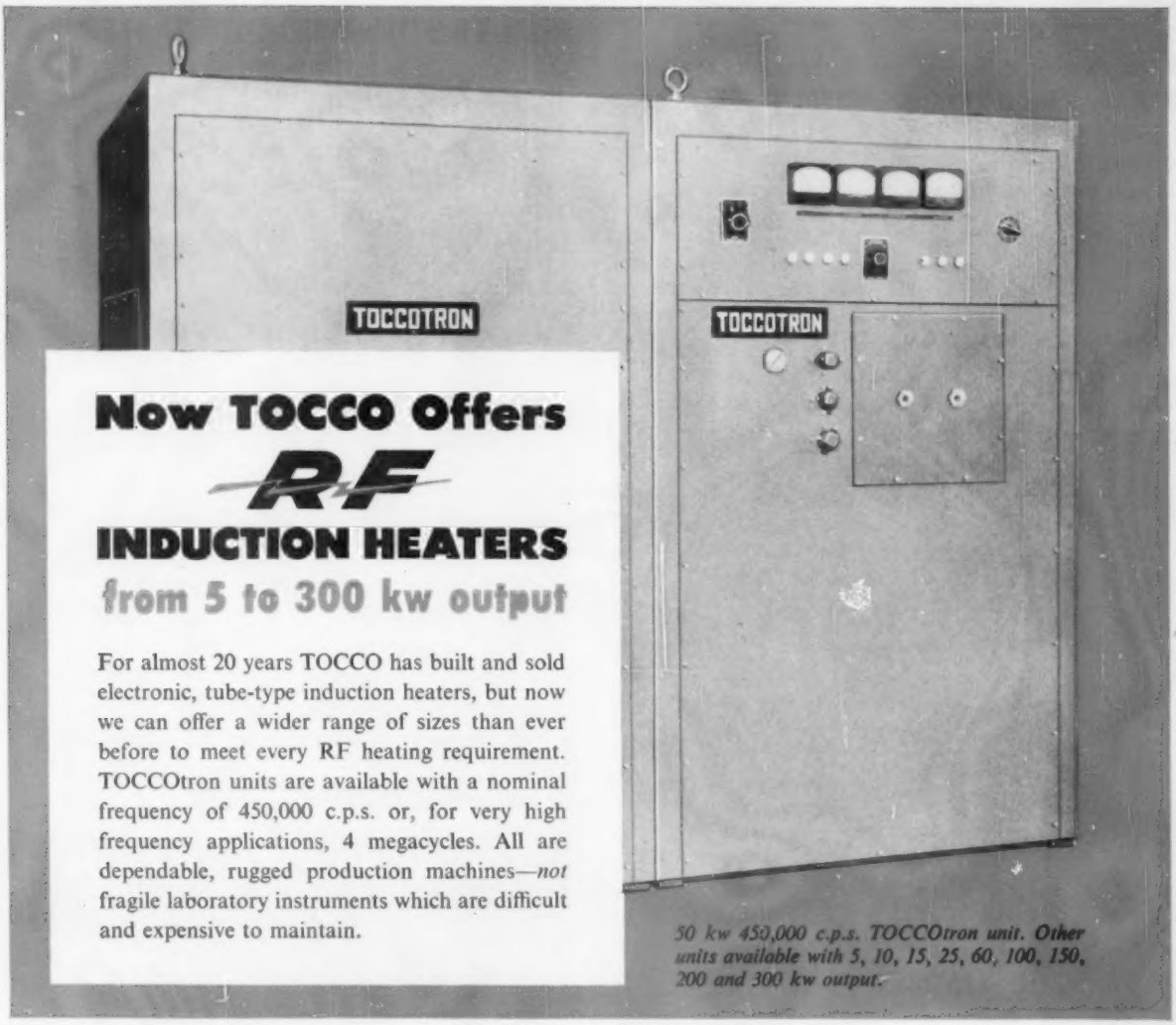

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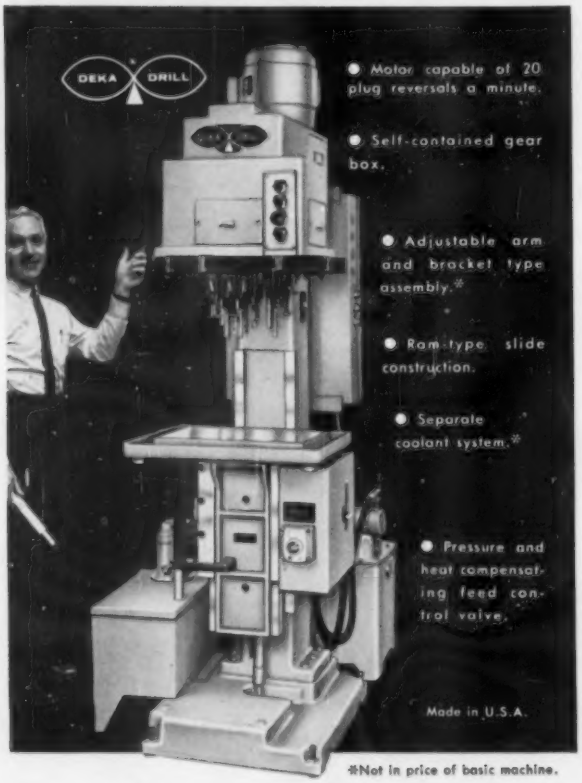
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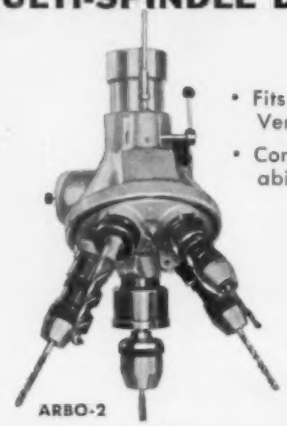

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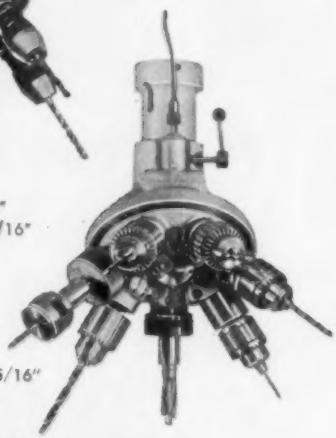

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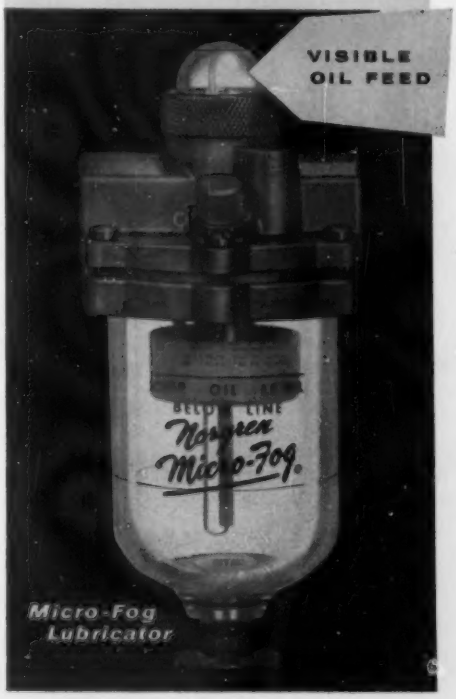

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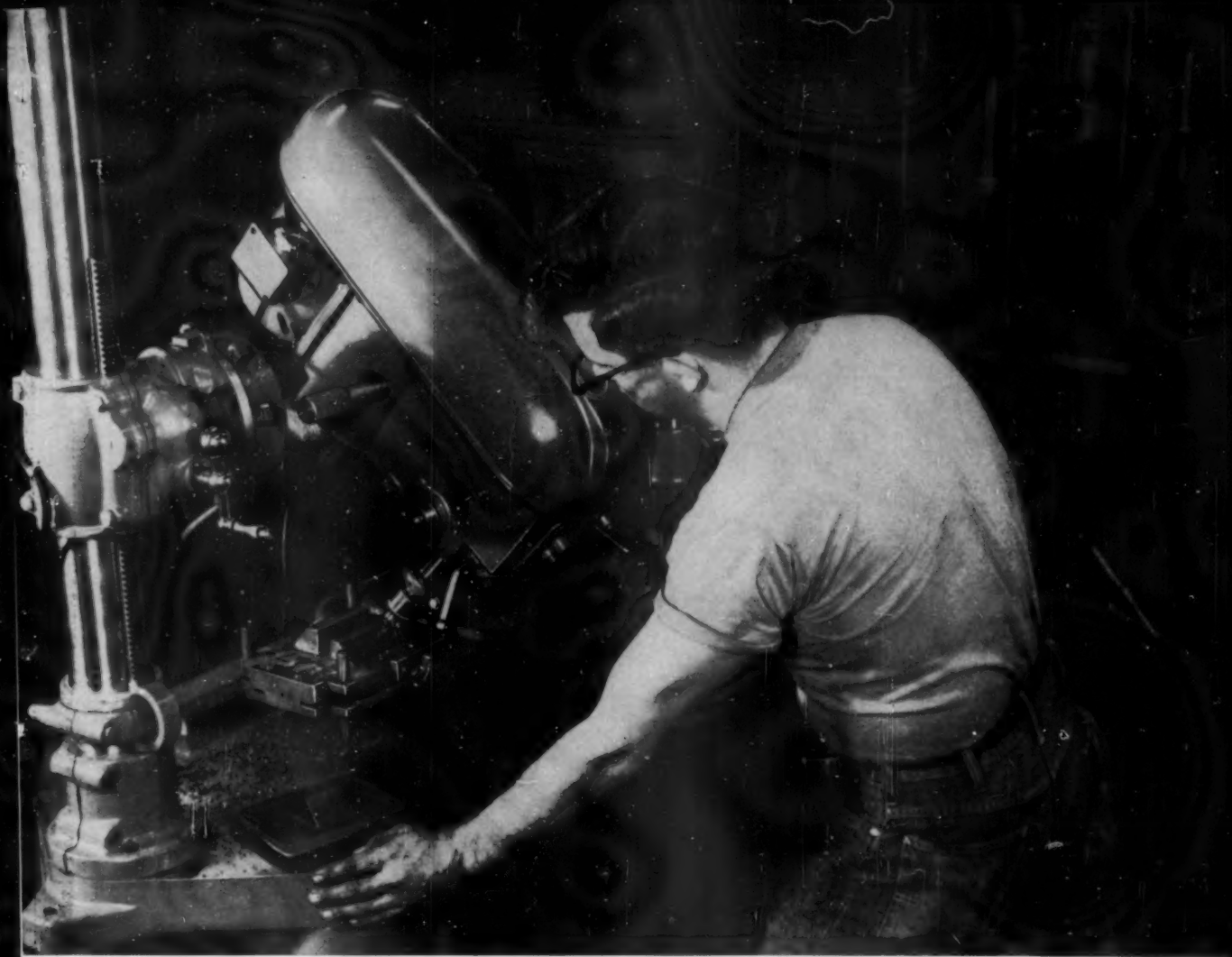

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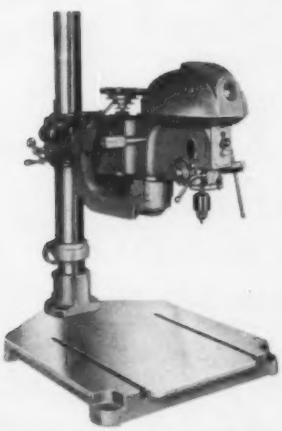

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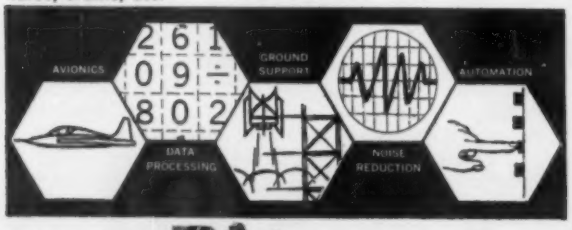

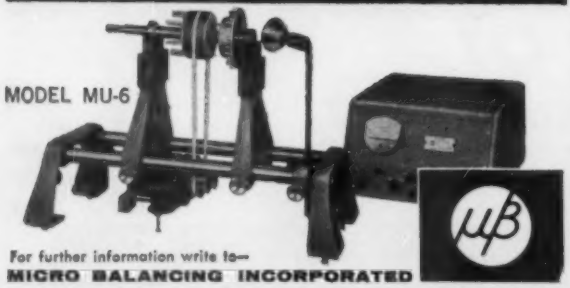

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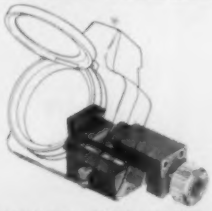

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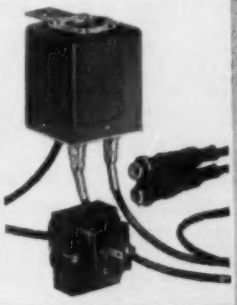

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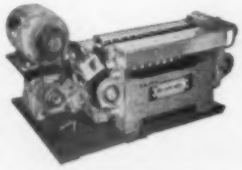

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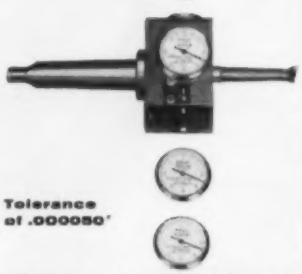

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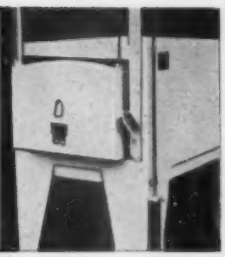

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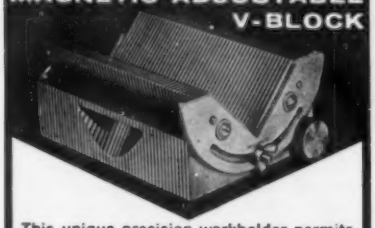

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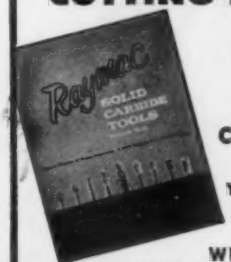

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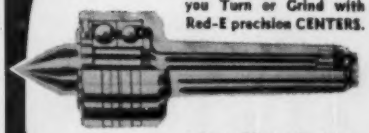

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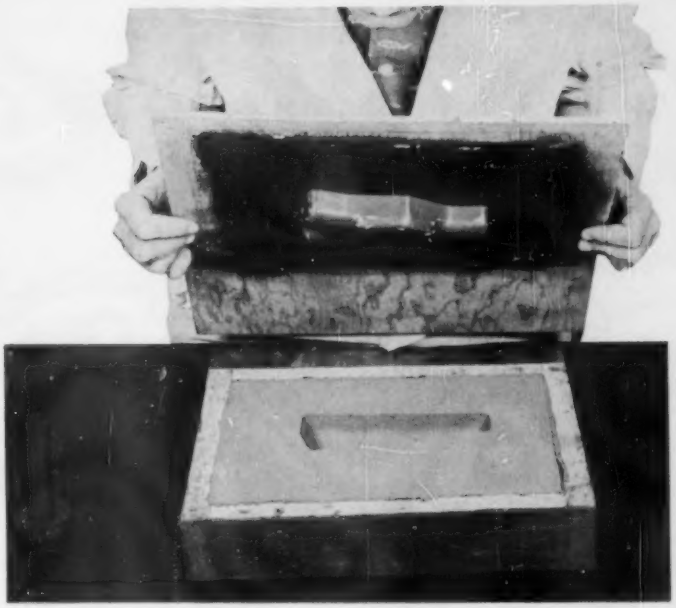

THIS is an example of short-run tooling. It is a plastic die, built to manufacture prototype parts. Many manufacturers are using tooling of this type to fabricate prototype parts before part design is finalized. Such tooling can be quickly modified if the prototype part design changes. Similar tooling is used to produce small production lots, running from a few dozen to a thousand parts. Low-cost tooling of all kinds for low-volume production has become the rule, rather than the exception in hundreds of plants. It is used for presswork, for machining, for inspection.

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Index to Advertisers

October 1961

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*Exhibitor in 1961 ASTME Tool Exposition POSDICK JOB APPLICATION AD RATING †1961 Manufacturing Planning Issue

Most of the companies listed below have informative listings in the 1961 Suppliers Directory Issue

A

Ace Drill Corp. 173
*ACF Electronics Division, ACF Industries, Inc. 180
Acme Industrial Co. 172
*Airetool Mfg. Co., The 172
Alina Corp. 181
Instrument Division 135
Machine Division 151
*Allegheny Ludlum Steel Corp. .. 50
Carmet Division 28
*†American Drill Bushing Co. 2
*†American Society of Tool and Manufacturing Engineers 154, 188, 214, 215
†Ames Co., B. C. 30
Anaconda American Brass Co. .. 63
Anton Machine Works 213
Armstrong-Blum Mfg. Co. 126
*Armstrong Brothers Tool Co. 156
*Automatic Mill, Inc. 212

B

†Barber-Colman Co. 42-43
Bath & Co., Inc., John 51
Bay State Tap & Die Co. 19
Beatty Machine & Mfg. Co., Beatty-Quickwork Division ...174
*Bellows-Valvair 36
†Bethlehem Steel Co. 13
Black & Decker Corp., Master Power Corp., Subsidiary 56
Blanchard Machine Co., The ...203
Bliss Co., E. W., Press Division ..*Inside Back Cover*
Bokum Tool Co. 212
Boston Gear Works 58
*†Bridgeport Machines 54
*Bristol Co., The 164
*†Brown & Sharpe Mfg. Co. 44-45
Cutting Tools Division 149
†Bryant Chucking Grinder Co. 12
Bullard Co., The 17
Butterfield Division, Union Twist Drill Co. 152-153

C

*Carmet Division, Allegheny Ludlum Steel Corp.. 28
*Cincinnati Milling Machine Co. . 6
†Circular Tool Co. 148
Classified Ads 214
†Clearing Machine Corp., Division U. S. Industries, Inc...*Back Cover*
Cleveland Crane & Engineering Co. 191
Cleveland Twist Drill Co. 18
†Cushman Chuck Co. 67

D

†Danly Machine Specialties, Inc. ..175
Delta Power Tool Division, Rockwell Mfg. Co. 209
*†Detroit Stamping Co. 130
Dexco Corp., Raymac Division 213
*Di-Acro Corp. 178
*DoAll Co. 64
Dow Chemical Co., The 132-133
*duMont Corp., The 212
*†Dumore Co., The 46-47
Dwight Instrument Co. 213
Dykem Co., The 195

Announcing . . .

ASTME 1962 ENGINEERING CONFERENCE and EXPOSITION

CLEVELAND
MAY 7-11, 1962

*

E

Edlund Machinery Co. 193
Electra Products Co. 212
Emhart Mfg. Co. 144-145
*Engelhard Hanovia, Inc., Industrial Diamond Division .. 60
National Electric Instrument Division 188
*Ettco Tool & Machine Co., The ..204
†Ex-Cell-O Corp., Continental Division 29
Machinery Division 21, 23, 25, 27, 31
Optical Gaging Products Subsidiary 33

F

†Federal Products Corp. 16
Ford Mfg. Co., M. A. 200
Fortune Industries 195

G

*Gaertner Scientific Corp. 187
Gardner-Denver Co. 189
Gatco Rotary Bushing Co. 213
General Dynamics Corp., Advanced Products Dept. 72
†Giddings & Lewis Machine Tool Co., Davis Division 8
Gilman Co., Russell T. 163
*Gisholt Machine Co. 4
Gorton Machine Co., George 199
†Greenfield Tap & Die Co. 197
Greenlee Bros. & Co. 168

H

*Hamilton Watch Co. Precision Metal Division 201
Hardinge Brothers, Inc. 9
*Harig Mfg. Corp. 157
Hartford Special Machinery Co. .195
Heald Machine Co., Subsidiary Cincinnati Milling Machine Co. .....*Inside Front Cover*
Holcroft & Co. 133
*Huron Machine Products, Inc. ..188
Hunt Valve Co. 15

I

†Ideal Industries, Inc. 208
Induction Heating Corp. 167
*Industrial Diamond Division, Engelhard Hanovia, Inc. 60

J

*Jarvis Corp. 186
Jersey Mfg. Co. 206

K

*Kennametal, Inc. 198
Kingsbury Machine Tool Corp... 62

L

Lees-Bradner Co. 39
*Lepel High Frequency Labs 173
Lindberg Engineering Co. 70-71
Loeffel Co., The Arthur 34-35
*†Lufkin Rule Co. 192

M

M-B Products Corp. 200
†Manhattan Rubber Division, Raybestos-Manhattan, Inc. ...196
Marshall Steel Co. 200
Master Power Corp., Subsidiary, Black & Decker Corp. 56
McCrosky Tool Corp. 135
Meyer Co., Inc., W. F. 210
*Micro Balancing, Inc. 210
Morton Machine Works 195

N

National Acme Co., The 26
*National Electric Instrument Division, Englehard Hanovia, Inc. 188
National Machinery Co. 160
National Twist Drill & Tool Co. 147
New Britain Machine Co., Gridley Division 65-66
Nirol Mfg. Co. 212
Norgren Co., C. A. 207

O

*†Oakite Products, Inc. 131
*Oberg Mfg. Co. 134
Ohio Crankshaft Co., Inc. 205
†Optical Gaging Products, Subsidiary Ex-Cell-O Corp. 33
Ortman-Miller Machine Co. 178

P

Pacific Industrial Mfg. Co. 200
Pangborn Corp., Vibratory Finish Division 136
Parker-Hannifin Corp. Hannifin Co., Division .....150 Machinery Division 162
*Parker-Kalon Corp., Division General American Transportation Co. 137
Perfecting Service Co. 150
†Pipe Machinery Co. 59
Pope Machinery Corp. 11
Precision Tool & Mfg. Co. 206
*Producto Machine Co., The 14
Putnam Tool Co. 139-142

R

†Raybestos-Manhattan, Inc., Manhattan Rubber Division ...196
Raymac Division, Dexco Corp. 213
Ready Tool Co. 213
Reed Rolled Thread Die Co..184-185
Rockwell Mfg. Co., Delta Power Tool Division ...209 Walker-Turner Division 166
Roto-Finish Corp. 37-38
Russell, Holbrook & Henderson, Inc. 22
Ryerson & Son, Inc., Jos. T. 74

S

*†Scully-Jones and Co. 24, 192
*Sentry Co., The 210
*Service Machine Co. 204
*Sheldon Machine Co. 158
*Simonds Saw & Steel Co. 49
*Simpson Optical Mfg. Co. 211
†Standard Electrical Tool Co. 194
*Standard Tool & Mfg. Co. 68
Standard Tool Co. 165
Star Cutter Co. 69
*Starrett Co., The L. S. 55
Stocker & Yale, Inc. 202
Sturtevant Co., P. A. 206
*Sun Oil Co. 159
*†Sunnen Products Co. 53
†Super Tool Co., Division Van Norman Industries, Inc. .. 40
*†Superior Die Set Corp. 176
Sutton Tool Co. 218
Swartz Standard Fixture Division Universal Vise & Tool Co. 202

T

Techno-Products Corp. 213
Timken Roller Bearing Co. 48
Titan Tool Co. 204

U

Unimet Carbides Corp. 61
†U. S. Industries, Inc., Clearing Machine Corp. .....*Back Cover*
Universal Cyclops Steel Corp. ...190
Universal Vise & Tool Co. Swartz Standard Fixture Division 202

V

Vanadium-Alloys Steel Corp. ... 32
Vascoloy-Ramet Mfg. Corp. 124
*Vlier Engineering, Inc., Wespo Division 52

W

Waldes Kohinoor, Inc. 41
Walker-Turner Division, Rockwell Mfg. Co. 166
†Weldon Tool Co., Inc. 10
*Wespo Division, Vlier Engineering, Inc. 52
*Whistler & Sons, Inc., S. B. 204
†Whitman & Barnes, Inc. 179
Wiedemann Machine Co. 57
Winter Brothers Division, National Twist Drill & Tool Co. 146
Woodruff & Stokes, Inc.....145, 202
†Woodworth Co., N. A. 182

Z

†Zeiss, Inc., Carl 20

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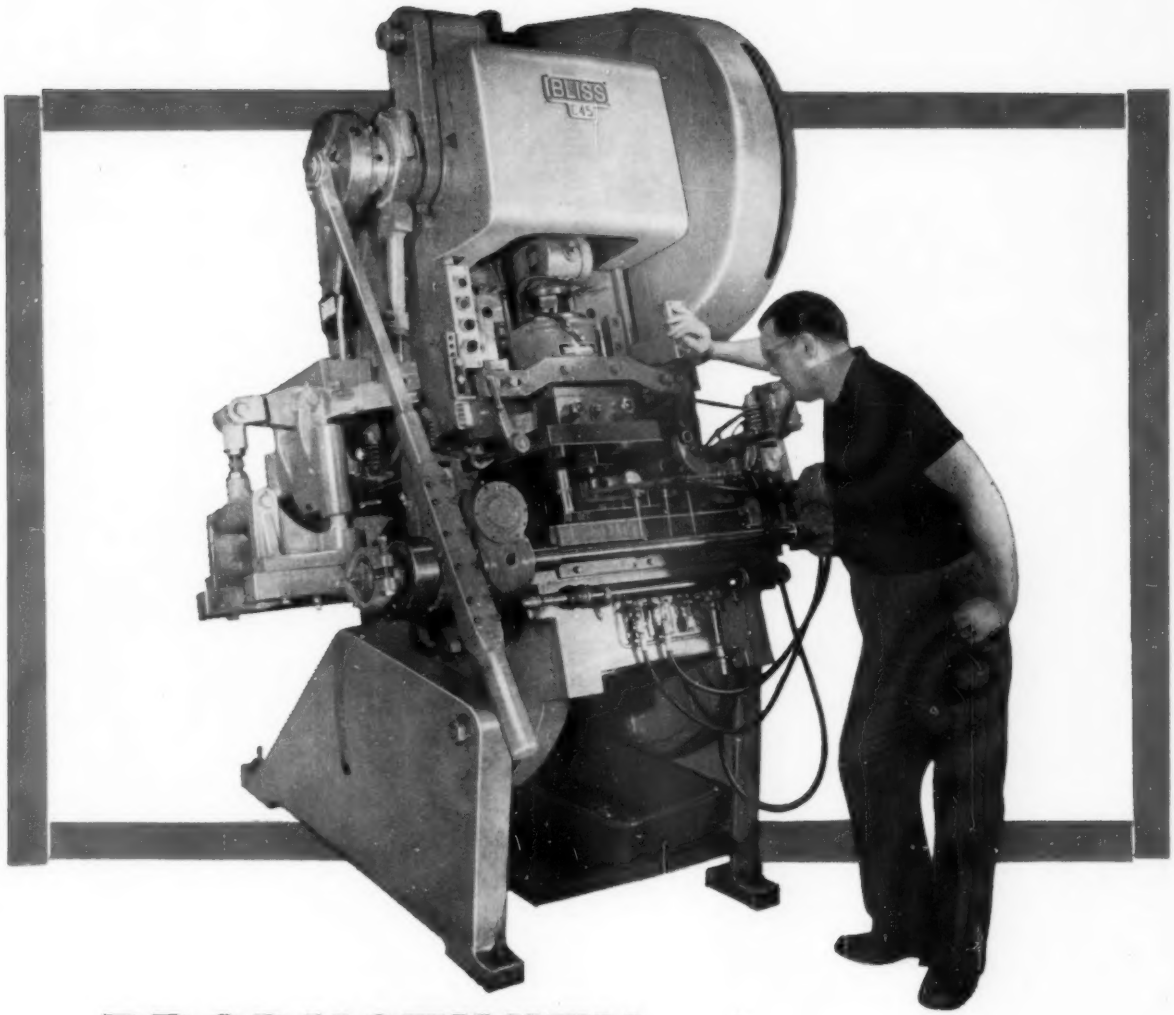

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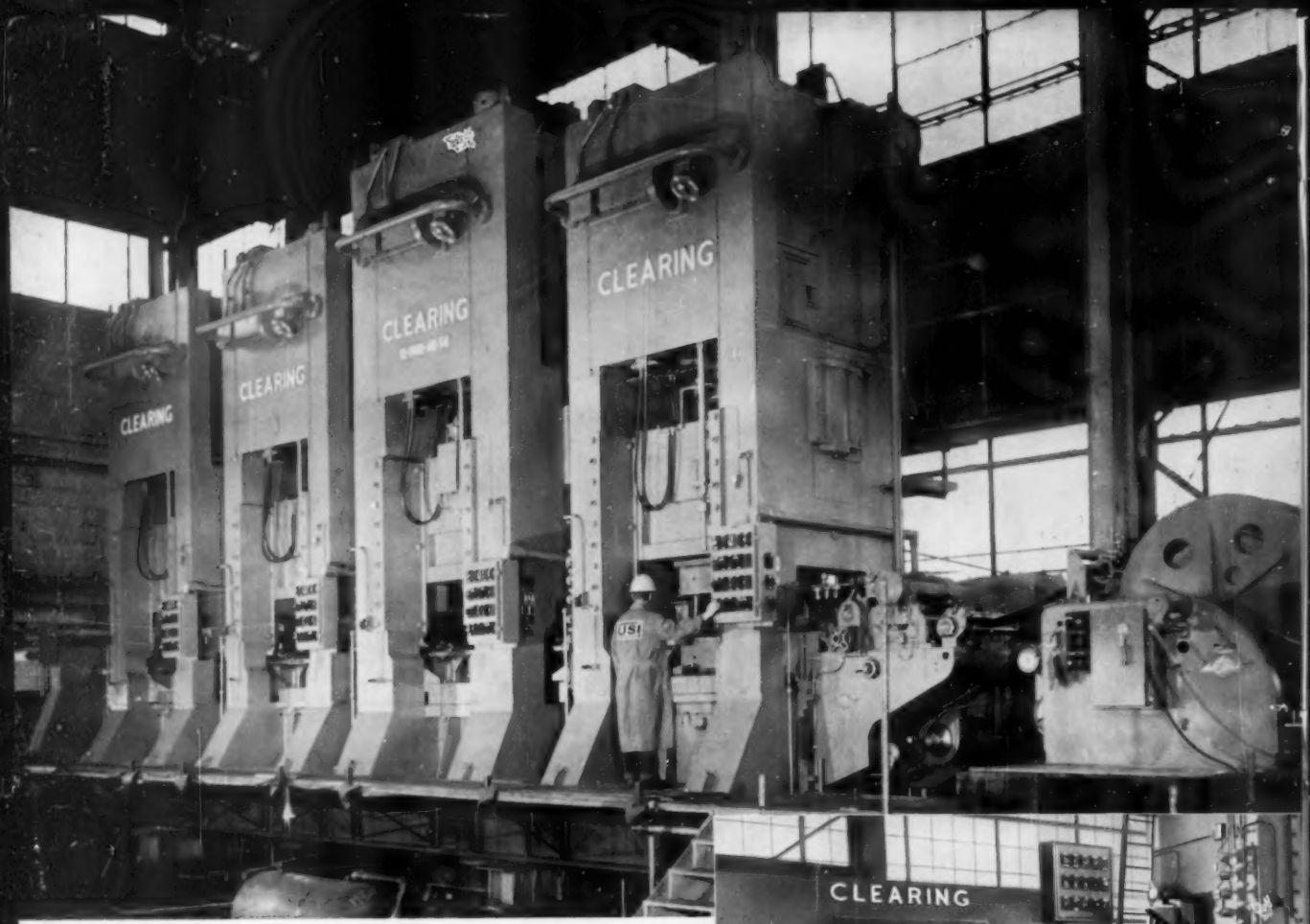

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